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ABSTRACT

The National Education Longitudinal Study of 1988 (NELS:88) is the third in a series of longitudinal studies sponsored by the National Center for Education Statistics. This report profiles the mathematics and science instruction received by eighth graders (11,414 surveyed in mathematics and 10,686 in science) in public and private schools in 1988 and proposes to trace the participants into the 10th and 12th grades. A preface lists highlighted findings, tables, and figures included in the document. The body of the report consists of five chapters. Chapter I discusses the purpose and format of the report and limitations of the study. Chapters II and III examine the relationship of various aspects of mathematics and science instruction to students' socioeconomic status and race-ethnicity and type of school attended. Among the aspects examined were the major topics taught, average class size, hours per week attended, allocation of class time, assigned homework, availability of instructional materials, student attitudes toward mathematics and science, and teacher characteristics and qualifications. Chapter IV examines mathematics and science achievement test scores in relation to the various components of instruction measured in the study. Chapter V provides a descriptive profile of the mathematics curriculum, the science curriculum, teacher characteristics and qualifications, classroom characteristics, school type differences, and students' opportunity to learn based on the findings. Appendices that describe the methodology employed and standard errors of estimates reported in tables and figures in the text are provided. (MDH)

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A Profile of American Eighth-Grade Mathematics and Science Instruction

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Statistical Analysis Report June 1992

National Education Longitudinal Study of 1988

A Profile of American Eighth-Grade Mathematics and Science Instruction

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June 1992

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Highlights

Mathematics and Science Instruction for Public School Eighth Graders[1]

Mathematics and Science Curricula

Twenty-nine percent of American public school eighth graders reported attending an algebra or other advanced mathematics class; 17 percent reported attending a general mathematics class as well as participating in an accelerated mathematics (enriched) program; 47 percent reported attending only a general mathematics class; and 7 percent reported attending some kind of remedial class.

According to eighth-grade teachers, students in general and remedial classes concentrated on more elementary topics such as ratios/percents and fractions, where their exposure to more advanced topics was more broadly distributed. However, eighth-grade teachers reported that students in more advanced classes concentrated primarily on algebra, problem solving, and integer topics, and their exposure to more elementary topics was low.

Ninety-six percent of eighth graders reported attending a science class; among them, 22 percent reported being in science classes that had laboratories. Nearly 60 percent of eighth graders were in science classes where their teachers reported that science experiments were conducted once a week or more; 21 percent were in classes where experiments were seldom conducted (less than once a month).

The most prevalent topics taught in eighth graders' science classes were earth science (57 percent of the students had science teachers who reported teaching this as a major topic) and weather/astronomy (55 percent). Other topics commonly covered were environmental science (48 percent), chemistry (46 percent), and various physics or atomic theory topics (41 percent).

There were large socioeconomic status (SES) and racial–ethnic differences in levels of participation in various mathematics and science curricula.

- Blacks and Hispanics were almost twice as likely as white students to be in a remedial mathematics class.
- Low-SES students were more than twice as likely as high-SES students to be in a remedial mathematics class.
- Nearly 50 percent of high-SES students reported attending algebra or advanced classes, compared with 28 percent of middle-SES students and only 15 percent of low-SES students.
- High-SES students were more likely than low-SES students to report conducting experiments in science classes daily (19 percent versus 9 percent).

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[1] A detailed examination of mathematics and science instruction was conducted for public school students (about 87 percent of the NELS:88 eighth graders). The small sample size of private school students precluded such a detailed examination of instruction. However, comparisons were made between public and private school students (see final section of Highlights).

Student Achievement

While the direction of causality cannot be determined with the NELS:88 Base Year Survey, one of the major differences among high- and low-achieving students in mathematics was the class type attended. Students in algebra or other advanced classes where algebra was taught as a major topic had the highest mathematics achievement test scores. Students in remedial classes or those in classes where elementary subjects such as fractions were taught as a major topic had the lowest achievement test scores.

Similarly, among eighth graders studying science, the frequency with which students conducted science experiments was related to science achievement test scores. Students who were in classes that conducted experiments at least once a week had higher scores than students who were in classes in which experiments were conducted less than once per month. In addition,

- Students whose teachers had majored in mathematics (or math education) performed significantly better than those whose teachers had majored in education only. This was not true for science.
- Students who had the least experienced mathematics teachers (with 3 or fewer years of experience) scored lower than students whose teachers had 10 or more years of experience.
- Students who were assigned 3 to 4 hours of homework per week in mathematics classes performed higher in mathematics achievement than students who were assigned less than 1 hour of homework per week.

Class Size and Time and Group Allocation

- About 45 percent of eighth graders were in mathematics or science classes with 16 to 25 students. Eleven percent and 6 percent, respectively, were in mathematics and science classes that had fewer than 15 students.
- About 60 percent of eighth-grade mathematics and science students' teachers reported spending half or more of their classroom time in whole-group class instruction.

Homework

About two-thirds of eighth graders were in mathematics or science classes where their teachers assigned from 1 to less than 3 hours of homework per week (math: 65 percent; science: 73 percent). Certain subgroups were less apt to receive large amounts of homework.

- Nearly 30 percent of students were in mathematics classes where 3 or more hours of homework were assigned per week, compared with 16 percent of eighth graders who were assigned 3 or more hours of science homework.
- About 6 percent of eighth graders were in mathematics classes where less than 1 hour of homework per week was assigned; 11 percent of eighth graders were in science classes where less than 1 hour per week of homework was assigned.

- Students enrolled in remedial mathematics classes were twice as likely as students in algebra or advanced classes to be assigned less than 1 hour of homework a week (10 percent versus 4 percent).

Student Attitudes

More than one-half of eighth graders looked forward to their classes in mathematics (57 percent) and science (62 percent). While nearly 90 percent of eighth graders thought that mathematics was important to their future, only 70 percent felt that way about science. However, some subgroup attitude differences were seen.

- About 21 percent of eighth graders were afraid to ask questions in mathematics class, while 14 percent were afraid to do so in science class.

- While low-SES students tended to look forward to mathematics more than high-SES students, they were more afraid to ask questions.

Teacher Qualifications

- While almost all (97 percent) of public school eighth graders' mathematics teachers felt well to very well prepared to teach mathematics, only 70 percent of them had majored or minored in mathematics (or math education) in college. Eighteen percent had majored in education only, and 12 percent had majored in another subject.

- Eighty-four percent of public school students had science teachers who felt well to very well prepared to teach science. Seventy-two percent of public school eighth graders had science teachers who had majored or minored in science in college. Fifteen percent had teachers who had majored in education only, and 13 percent had majored in another subject.

- Nearly 70 percent of students had mathematics or science teachers with 10 or more years of teaching experience; less than 15 percent had mathematics or science teachers with 3 or fewer years of experience.

Public and Private School Differences

In this report, differences between public schools and three types of private schools (Catholic; private other religious; and private, nonreligious) were examined.

- A greater percentage of private, nonreligious school students (58 percent) reported attending algebra or advanced mathematics classes than public school students (29 percent).

- A greater percentage of Catholic school students reported attending remedial mathematics classes than students in all other school types.

- Private nonreligious and private other religious school students tended to participate in smaller mathematics and science classes (as reported by their teachers) than public and Catholic school students.

- A greater percentage of public school students had mathematics teachers who reported majoring in mathematics (43 percent) for their bachelor's degree than did Catholic school students' teachers (18 percent). This pattern did not hold for the percentage of science teachers who had majored in science.

Foreword

The National Education Longitudinal Study of 1988 (NELS:88) is the third in a series of longitudinal studies sponsored by NCES; the first two are the National Longitudinal Study of the High School Class of 1972 (NLS-72), and High School and Beyond (HS&B). Whereas NLS-72 and HS&B focused mainly on the educational, vocational, and personal development of 10th and 12th grade respondents, NELS:88 is broader in scope. It is being conducted in several waves: the first describes the experiences of the students as 8th graders; the second will trace them in the 10th grade; and the third will follow them to the 12th grade. Additional followups will come at 2-year intervals. The longitudinal design of NELS:88 allows researchers to observe not only the critical transition of students from middle or junior high school to high school, but also to identify early student, school, and parental experiences that promote student learning.

Teachers also participated in NELS:88. They were selected on a pre-assigned basis in two of four subject areas—mathematics, science, English, and social studies (history/government). Each school was randomly assigned to one of the following combinations of curriculum areas: mathematics and English; mathematics and social studies; science and English; or science and social studies. At any school, each sampled student's current teacher(s) in each of the two designed subject areas was selected to receive a teacher questionnaire. This selection procedure was designed to ensure representation of mathematics, science, English, and social studies curricula in all schools.

This report profiles the mathematics and science instruction received by eighth graders in 1988. Data from both the student and the teacher surveys were used. The teacher component of the NELS:88 survey, however, does not constitute a nationally representative sample of eighth grade teachers. NELS:88 teachers were not independently selected and their inclusion in the sample depended upon their linkage to a student who was selected for the survey. Therefore, in this study the student is the basic unit of analysis: the mathematics and science instruction characteristics were analyzed in relation to student-teacher pairs. Approximately half of the students surveyed had a math teacher surveyed (11,414), while the other half had a science teacher surveyed (10,868). Overall, approximately 91 percent of the students surveyed had either a math or science teacher surveyed.

The NELS:88 Base Year Survey provides a wealth of information concerning 1988 eighth grade mathematics and science instruction. Using these data we have been able to profile the experiences of eighth graders in their mathematics and science classes in relation to curricula, classroom characteristics, achievement, teacher qualifications, and student attitudes toward mathematics and science.

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Chapter I

Introduction

According to recent reports examining international achievement in mathematics and science, American students lag far behind their counterparts from other countries.[1] In a recent assessment of educational progress, 13-year-olds from the United States, Canada, Iceland, Korea, the United Kingdom, and Spain were assessed in math and science proficiency. Students in the United States placed in the lowest scoring group in mathematics and in the second-to-lowest group in science.[2]

Researchers attribute low performance to various causes, including: 1) a low emphasis on mathematics relative to reading; 2) the grouping of students by ability (tracking) in U.S. schools; 3) a repetitive mathematics curriculum; 4) unequal opportunities for students to learn mathematics; and 5) teacher beliefs and attitudes about learning mathematics.[3] Although individual factors such as student aptitude and socioeconomic status are still believed to account for a large proportion of the variation in explaining achievement, it is possible that instructional variables are more important than previously recognized.[4]

Recently, the condition of middle and junior high school education has become a topic of great interest to the general public. Because middle school students are preparing for high school and determining which educational programs will be most useful to their future, they are at a pivotal point in their lives. This is an especially critical time for eighth graders because they must choose what type of mathematics curriculum they will pursue in high school. If students are disinterested in school or are low achievers, they are generally assigned to remedial or basic level classes. As a result, these students are unlikely to be prepared for advanced high school mathematics or science at an early age, and may be tracked as individuals who will be ill-prepared to enter a technology-oriented work force.[5]

A major problem facing educators in the scientific community today is that quality mathematics and science instruction is often less accessible to low-income and minority students. In addition, a disturbing nationwide pattern is emerging: teachers who are less experienced and less well prepared to teach in their field are instructing children from the lowest academic and socioeconomic backgrounds. In short, higher ability children and those from advantaged backgrounds are more likely than children of low ability and those from disadvantaged backgrounds to have well-trained, experienced teachers.[6]

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[1] Lapointe, A., Mead, N. and Phillips, G., *A World of Differences*. Princeton, NJ, ETS, 1989.

[2] Ibid.

[3] McKnight, C., Crosswhite, F., Dossey, J., Kifer, E., Swaffort, J., Travers, K. and Cooney, T., *The Underachieving Curriculum*. Champaign, IL, Stipes Publishing, 1987.

[4] Brophy, J. and Good, T., "Teacher Behavior and Student Achievement," in M.C. Wittrock (ed), *Handbook of Research on Teaching*, (3rd ed), New York, McMillan, 1987.

[5] National Science Foundation, *Women and Minorities in Science and Engineering*, NSF 88-301, Washington, D.C., 1988.

[6] J. Oakes, *Excellence and Equity: The Impact of Unequal Educational Opportunities*, Santa Monica: The Rand Corporation, 1990, and J. Oakes, *Multiplying Inequalities*, Santa Monica: The Rand Corporation, 1990.

Determining Teacher and Classroom Indicators

To improve student math and science performance, it is necessary first to define and develop reliable indicators of teacher and classroom quality in order to assess the current state of mathematics and science education. In particular, both the quality of teaching and of the teachers themselves are considered to be important process indicators of current classroom instruction. Such process measures, which describe instructional practice and the degree to which quality education is available to all students, can help researchers investigate whether children from disadvantaged families have the same opportunities to learn important mathematical and scientific skills (such as higher-order thinking and problem-solving skills) as more advantaged children. These process measures may also help educators understand discrepancies in student performance.[7]

Some researchers argue that past studies on classroom processes have primarily focused on the "intended curriculum," such as the kinds of textbooks that have been used. Consequently, they suggest that the "implemented curriculum"[8]—which refers to how teachers present the curriculum, teachers' beliefs and interests, and the context in which instruction occurs—has been ignored.

Both teacher and classroom variables are increasingly being recognized as equally important determinants of student achievement as background factors such as socioeconomic status. For example, in a recent meta-analysis of variables related to learning, it was found that the quality and quantity of instruction were roughly equal to student characteristics and out-of-school contextual variables in explaining student achievement levels.[9] In particular, "time-on-task" (content coverage or opportunity to learn) was found to be the most frequently cited variable in the instructional arena. Similarly, researchers argue that variables in the implemented curriculum are major factors in explaining the relatively poor educational achievement of students in the United States as compared with that of their counterparts in other countries.[10] Thus, as the literature suggests, monitoring changes in student exposure to quality curricula seems to be of critical importance from a policy perspective in determining whether or not our international achievement standing is likely to improve in the future.

Experts do not always agree on definitions of teaching quality, but some basic indicators can be useful. In a recent sourcebook on educational indicators, the authors maintain that *teacher* quality (the knowledge and skills of a teacher) is an important predictor of *teaching* quality (such as topic coverage or time allocation).[11] Moreover, this review of the research showed that academic knowledge and preparation in a subject area are related to student learning, particularly in mathematics and science.

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[7] Travers, K. and McKnight, C., "Mathematics Achievement in U.S. Schools: Preliminary Findings from the Second IEA Mathematics Study," *Phi Delta Kappan*, February 1985, 407–413.

[8] Cooney, J. and Dossey, J., "Classroom Processes: The Linkage Between Intentions and Outcomes," Champaign, IL, IEA occasional paper, 1983, and Travers, K. and McKnight, C., "Mathematics Achievement in US Schools: Preliminary Findings from the Second IEA Mathematics Study," *Phi Delta Kappan*, February 1985, 407–413.

[9] Wang, M., Haertel, G., and Walberg, H., "What Influences Learning? A Content Analysis of Review Literature," Philadelphia, Temple University Center for Research in Human Development and Education, 1988.

[10] Cooney and Dossey, 1983, and Travers and McKnight, 1985.

[11] R.J. Shavelson, L.M. McDonnell, and J. Oakes, eds., *Indicators for Monitoring Mathematics and Science Education*, Santa Monica, The Rand Corporation, 1989.

Other research suggests that although various teacher preparation and qualification measures have been examined for their relationship to student learning, such studies have had equivocal results.[12] There is some support for the idea that a teacher with better subject-matter knowledge is, in fact, a better teacher.[13] In addition, knowledge of teaching methods in a particular subject area is also considered to be an important measure of teacher quality. For example, in one study, the number of credits a teacher had earned in mathematics methods courses was found to be the most strongly related "teacher preparation variable" to student performance.[14]

Also of interest is the match between teacher assignment and preparation and certification field, since it is considered undesirable to teach outside of one's specific instructional area. However, one problem with using certification as a teacher quality indicator is the fact that states vary in their requirements for certification. In addition, almost all public school teachers are fully certified, and little association has been demonstrated between certification status and student achievement.

Using the NELS:88 survey data, a number of important teacher and classroom-level characteristics can be used as indicators to examine the instructional condition of American eighth-grade mathematics and science education. For example, the curriculum-level measures included for mathematics instruction in this analysis are the class level (track) reported by students and the intensity of exposure to algebra and other mathematics topics reported by teachers. For science, the amount of exposure students had to scientific experimentation and the intensity with which science topics were covered are examined. The classroom-level characteristics that are analyzed here include class size and grouping allocations; classroom resources, such as access to microcomputers and calculators; and the amount of homework assigned. Finally, the teacher qualifications that are reported include teachers' highest level of education, baccalaureate major, their self-assessment of how prepared they are to teach their respective classes, and the number of years of teaching experience.

Purpose of This Report

This report presents selected teacher and classroom characteristics that help define the condition of American eighth-grade mathematics and science instruction. Specifically, the report 1) presents a descriptive profile of mathematics and science instruction in eighth-grade classes, 2) describes differences in the instructional conditions for various types of students and different types of schools, and 3) relates instructional conditions to student achievement.[15] Using the measures of instructional quality presented, the following policy-relevant questions are addressed:

- What percentages of students are enrolled in various levels of mathematics courses such as algebra or advanced courses, general courses, and remedial courses?

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[12] L. Darling-Hammond and L. Hudson, "Precollege Science and Mathematics Teachers: Supply, Demand and Quality," *Review of Educational Research*, 16, 1990, 223–264.

[13] See Byrne, "Teacher Knowledge and Teacher Effectiveness," paper presented at the meeting of the Northeast Educational Research Association, New York, 1983.

[14] Begle, E., *Critical Variables in Mathematics Education*, Washington D.C., Mathematics Association of America and NCTM, 1979.

[15] No causal relationship between instructional practices and student achievement is assumed due to the cross-sectional nature of the NELS:88 base year survey.

- What are the major topics covered in mathematics and science classes, and how do they differ for various types of students (for example, students from different levels of socioeconomic status or remedial versus regular mathematics students)?
- What types of instructional materials and equipment are available in mathematics and science courses?
- How often do students conduct science experiments, and what type of equipment is available?
- How qualified are eighth graders' mathematics and science teachers?
- Do students from different backgrounds (that is, with varied socioeconomic and racial–ethnic characteristics) have equal access to quality teachers and instruction?
- How does both the instruction received by students and teacher quality relate to mathematics and science achievement test scores?

Limitations of the Study

It is important to keep in mind that although the eighth-grade student sample is nationally representative, the teacher component of NELS:88 does not constitute a nationally representative sample of eighth-grade teachers. Using the student as the basic unit of analysis, the mathematics and science instructional characteristics were analyzed in relation to student–teacher pairs (see appendix A for discussion).

Overall, about 91 percent of the eighth graders had either their mathematics or science teacher surveyed. Approximately one-half of the students had their mathematics teacher surveyed (11,414), while the other half had their science teacher surveyed (10,868). The type of teachers (mathematics or science) was selected on a random basis, so that students in each of these samples should be representative of the total sample.

In addition, the NELS:88 data used here are from the base year survey of an ongoing longitudinal study, and, thus, are only cross-sectional. Cross-tabulations were used to look at differences, and no causal inferences were drawn about the influence of instructional characteristics on achievement. The relationships presented are bivariate associations unadjusted statistically for covariates. Thus, many of these associations may be related to a third variable. Some of these possibilities are pointed out, however, others not discussed may be present. All comparisons cited in the text were made using Students' t tests. Bonferroni adjustments for multiple comparisons were made where appropriate. (See appendix A for a more detailed description of the procedure.) Unless otherwise indicated, all comparisons are significant at the $p \leq .05$ level.

Format of the Report

This report contains four additional chapters. The next chapter (chapter 2) provides a detailed description of findings for public school students and describes how student background, community type, and school environment are related to selected characteristics of teachers and mathematics and science instruction.[16] This chapter focuses on the influence of student characteristics such as socioeconomic status, race–ethnicity, and program tracking on the type of instruction received.[17] Chapter 3 compares findings for students in different types of schools (public and private). Chapter 4 examines achievement test scores and their relationship to various background variables. At the conclusion of the report, a summary chapter (chapter 5) reviews the major findings and the policy implications. Appendix A presents the methodology and technical notes, and appendix B includes standard errors and sample sizes for the figures and tables presented throughout the report.

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[16] This chapter focuses on public school students only. Because teacher qualifications and classroom characteristics (the primary focus of the study) can differ so much between public and private schools, a

The data presented in this report are from both the student and teacher surveys. The data were merged together making the student the unit of analysis. Sometimes the data in the tables or figures are student-reported information and the source of data reported for these numbers is the student survey only. However, the majority of the tables and figures present teacher-reported data and the table or figure titles make this clear. Since the student is the unit of analysis and the teacher data were merged with the students', the source of data for these tables and figures is reported as being from both the student and teacher surveys.

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separate chapter comparing school types is included. In addition, the small sample sizes of private school students makes it difficult to do a detailed analysis for instruction received in these types of schools.

[17] Overall, eighth-grade males and females in 1988 differed little in the type and scope of mathematics and science instruction they received. Therefore, the findings are not presented by gender.

Chapter II

Detailed Findings for Public School Students

This chapter examines public school mathematics and science instruction in detail. In particular, it examines how student background, community characteristics, and school environment are related to the ways in which students are taught mathematics and science. Comparisons are made for those components of mathematics and science instruction that show the greatest overall variation, as well as for those that represent a broad spectrum of teacher and classroom experiences. By investigating how mathematics and science instruction differs for students of various backgrounds, one can determine whether or not access to certain types of mathematics and science programs varies for students with different characteristics.

In this chapter, the relationship of students' socioeconomic status and race–ethnicity to various aspects of mathematics and science instruction was examined. In addition, this chapter investigates community attributes that might be associated with mathematics and science instruction. Schools are characterized by geographic region (Northeast, North Central, South, and West), community type (urban, suburban, or rural), and socioeconomic status. School socioeconomic status (SES) is approximated by looking at the percentage of students in the schools who received free lunches. The greater the percentage of students receiving free lunches, the poorer the school's population is presumed to be.

Finally, by examining several questions that school administrators were asked in the NELS:88 Base Year survey regarding the school climate, school environment is identified. These questions were grouped into three areas, and composite scales were created that represented 1) student problems, 2) teacher engagement, and 3) academic "press."

The student problems scale represents the degree to which administrators thought issues such as student absenteeism, alcohol and drug use, student weapon use, physical or verbal abuse of students toward teachers, and student theft were problems. The teacher engagement composite scale measures teacher morale and attitudes toward students. For example, administrators were asked whether there were conflicts between teachers and administrators in their schools, whether teachers had a negative attitude toward the students or had difficulty motivating them, and whether teacher morale was high. Finally, academic press indicates the intensity or competitiveness of the students toward their school work. This composite is a scale that included such questions as whether students placed a high priority on learning, whether teachers encouraged students to do their best, whether students were expected to do homework, and whether they faced competition for grades.[18]

Mathematics and Science Curricula

This section profiles the types of mathematics and science classes eighth graders attended, the major topics that were taught, the average size of these classes, the number of hours they met per week, how class time was allocated, the homework that was assigned, and what instructional resources were available (for example, availability of microcomputers, access to calculators in mathematics classes, and access to scientific equipment for science classes).

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[18] It should be remembered that these are school-level, not student-level indicators. Thus, they are general attributes of the entire school and not just of math and science instruction. See appendix A for a more detailed discussion.

Class Types

Mathematics. The National Survey of Practices and Trends conducted by the Johns Hopkins University Center for Research on Elementary and Middle Schools found that about three-quarters of eighth graders were grouped by ability level in some or all of their subjects. Mathematics was cited as being tracked most often (88 percent), while science was among the subjects least often grouped by ability (only 16 percent of all eighth graders).[19]

NELS:88 students reported participating in different levels of classes that were divided into four curricular areas: 1) participation in algebra or advanced classes ("algebra/advanced"); 2) participation in general mathematics *and* algebra ("enriched"); 3) participation in only general mathematics ("general"); and 4) participation in remedial mathematics ("remedial").[20]

Table 2.1 illustrates how students were distributed in the four curricula by socioeconomic status, race–ethnicity, and mathematics achievement test quartile. A substantial proportion (over 10 percent) of low-SES (bottom quartile), racial minority (Hispanics, blacks, and American Indians), and low-ability (bottom quartile cognitive test) eighth graders were participating in remedial programs. In particular, blacks and Hispanics were almost twice as likely as white students to be in a remedial course. Low-SES students were almost three times as likely as high-SES students to be in a remedial course.

Science. It is widely reported that teachers spend most of their instructional time in science helping students learn and memorize facts rather than teaching them to think scientifically. For example, in the National Survey of Practices and Trends, in the middle grades most principals indicated that their typical science teachers taught basic facts every day, but only about one-third reported that discussions of scientific methods are a regular part of lessons.[21]

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[19] J. H. Braddock, "Tracking the Middle Grades: National Patterns of Grouping for Instruction," *Phi Delta Kappan*, February 1990, 445–449.

[20] These curricular areas were determined by students' responses to questions about their participation in specific types of math classes. The categories presented are mutually exclusive and they are modeled on those presented in the report by McKnight et al., *The Underachieving Curriculum* (1987). Students were asked two separate questions about their math classes: one question asked whether they were participating in an advanced or accelerated program and the other asked what type of class they attended weekly: (1) algebra/advanced, (2) regular, or (3) remedial. Those students who answered they were attending a weekly algebra/advanced class were put in the "algebra/advanced" category. Those who answered they attended a weekly regular class and were in an accelerated program were put in the "enriched" category; those who attended a weekly regular class and were not in an accelerated program were put in the "general" category, and those who indicated they attended any remedial class were put into the "remedial" category. There is evidence that students overreport participation in algebra or other advanced classes (see NCES report, Kaufman et al., *The Quality of Responses in NELS:88 Survey*, September 1991). In addition, classification into these four groups differs from the classification used in *Profile of the American Eighth Grader*, NCES, 1990 which does not include the "enriched" category.

[21] H.J. Becker, "Curriculum and Instruction in Middle Grade Schools," *Phi Delta Kappan*, February 1990, 450–57.

Table 2.1--Percentage of 1988 public school eighth graders who reported attending different types of mathematics classes, by SES, race–ethnicity, and mathematics test quartile

	Algebra/ Advanced	Enriched	General	Remedial
Total*	29.0	17.1	47.1	6.9
Socioeconomic status				
Low	15.2	25.5	49.1	10.2
Middle	28.3	15.5	49.8	6.4
High	47.0	10.7	38.7	3.7
Race–ethnicity				
Asian	43.5	19.1	30.5	7.0
Hispanic	18.2	19.5	50.9	11.3
Black	24.6	28.1	37.3	10.0
White	30.9	14.5	49.1	5.5
American Indian	14.1	26.3	44.5	15.1
Mathematics test quartile				
Low	9.6	24.8	50.6	15.0
Middle	22.8	17.5	54.5	5.3
High	61.2	8.7	29.2	1.0

* For consistency, the students in this table are only those whose mathematics teachers were surveyed.
NOTE: Because of rounding errors, rows may not always add to 100 percent.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student" survey.

In the NELS:88 survey, almost all public school eighth graders (96 percent) reported attending science class, and among them, about 22 percent reported being in science classes with a separate laboratory. One way of determining how much hands-on work science teachers were giving to their students was to determine how often science experiments were demonstrated or conducted in class and the amount and condition of laboratory equipment available to students. Table 2.2 illustrates the varying exposure of eighth graders to scientific experimentation and equipment. Overall, a sizable proportion of students had little or no exposure to science experiments. For example, about 40 percent of public school students had little exposure (no more than once a month) to scientific experimentation. Almost one-half of students participated in classes where the teacher indicated that science experiments were conducted about once a week (47 percent of public school students).

About 18 percent of the students had teachers who reported that little to no equipment was available, while 47 percent of the students were in classes where equipment was available only for groups of three or more.

The equipment that was available to students was reported to be in relatively good condition: 58 percent of students had access to equipment in good to excellent condition as reported by their teachers. About 31 percent of students attended classes where teachers reported the equipment to be in fair condition, and the remaining 11 percent attended classes in which teachers reported the equipment to be in poor condition.

Table 2.2--Percentage of 1988 public school eighth graders whose science teachers reported varying exposure to laboratory experimentation

	Percent of Students
Number of science experiments conducted	
Total	100.0
None or less than one per month	20.6
About one per month	20.4
About one per week	46.9
Almost every day	12.2
Amount of science equipment available	
Total	100.0
Little to none	17.5
Enough for groups of 1 or 2 students to share	35.8
Enough for groups of 3 or more to share	46.6
Condition of science equipment if available	
Total	100.0
Poor	10.9
Fair	30.9
Good to excellent	58.3

NOTE: Because of rounding errors, categories may not always add to 100 percent.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Group differences were apparent in levels of participation in science experiments (table 2.3). For example, 41 percent of low-SES students were in science classes where experiments were conducted once a week and 9 percent were in classes conducting daily experiments, compared with 54 percent and 19 percent of high-SES students who conducted science experiments at the same frequencies.

Table 2.3--Percentage of 1988 public school eighth graders in science classes that conducted scientific experiments with varying frequencies, by student background, community, and school attributes

	Number of science experiments			
	None or <one/mo	About one/mo	About one/week	About one/day
Total	20.6	20.4	46.9	12.1
Socioeconomic status				
Low	29.2	21.3	41.0	8.5
Middle	20.4	21.7	46.9	11.0
High	11.6	16.2	53.5	18.7
Race–ethnicity				
Asian/Pacific Isl.	13.8	17.6	48.2	20.5
Hispanic	24.6	21.8	45.2	8.4
Black	23.2	24.1	43.3	9.5
White	19.7	20.0	47.4	12.9
American Indian/Alaskan Nat.	34.5	16.0	44.3	5.2
Community type				
Urban	20.6	20.1	44.8	14.5
Suburban	17.0	16.3	52.7	14.1
Rural	24.9	25.2	41.3	8.6
Percent free lunch				
≤ 5 percent	12.1	10.7	60.0	17.2
6–20 percent	14.2	22.4	45.6	17.8
21–50 percent	24.9	22.9	44.1	8.0
> 50 percent	33.5	23.8	37.9	4.8

NOTE: Because of rounding errors, rows may not always add to 100 percent.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Among racial–ethnic groups, Asian students were more likely than Hispanic students to be in science classes that conducted science experiments about once a day.[22] Students in schools with large free lunch programs—more than 50 percent receiving free lunches—were more likely to be in science classes where experiments were conducted less than once a month (about 34 percent) than were students who were in schools where less than 20 percent received free lunches (14 percent or fewer conducted experiments less than once a month).

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[22] While there appears to be a similarly large difference between Asian and black students, and an even larger difference between Asian and American Indian/Alaskan Native students, the differences were not statistically significant.

Topic Coverage in Eighth-Grade Mathematics

In the Second International Mathematics Study, conducted in 1981–82, researchers determined that the United States had a more diffuse and "arithmetic-driven" mathematics curriculum than other countries, allocating relatively equal amounts of time to various mathematics topics.[23] Japan, on the other hand, had a more intensive curriculum focused on algebra in the middle school years and calculus in the secondary school years. Similar to these results, findings from the NELS:88 survey suggested that the mathematics curriculum in middle schools consisted primarily of relatively broad survey-type courses, especially for lower-achieving students. Students who showed an aptitude for mathematics were often given instruction in pre-algebra, algebra, or other more advanced subjects in the eighth grade, while those who had not performed as well were more likely to have attended classes where arithmetic and computations dominated instruction.

In the NELS:88 survey, mathematics teachers were asked to identify which areas of mathematics were covered as major topics in their respective classes.[24] These topics included ratios and percents, problem solving, integers, fractions (common and decimal), algebra, geometry, measurement, and probability and statistics (table 2.4).

Table 2.4--Percentage of 1988 public school eighth graders whose mathematics teachers reported various subjects covered as major topics

Total (for each mutually exclusive topic)	100.0
Ratios and percents	78.1
Problem solving	72.7
Integers	69.3
Fractions (common and decimals)	67.7
Algebra	59.8
Geometry	50.7
Measurement	36.9
Probability and statistics	19.8

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

More than two-thirds of public school eighth graders were in classes where fractions, ratios and percents, problem solving, and integers were taught as major topics. These classes were followed by algebra (60 percent), geometry (51 percent), measurement (37 percent), and probability and statistics (20 percent). Figure 2.1 illustrates the difference in the intensity of the topics covered in the four curricular areas. This figure suggests a substantial differentiation of opportunity to learn mathematics within the curriculum. According to teachers, algebra, problem solving, and topics related to integers dominated the advanced curriculum and exposure to other subjects was relatively low. In contrast, students in general and remedial classes had teachers who concentrated on more elementary topics such as ratios/percents and fractions, and the students' exposure to other subjects was more broadly distributed.

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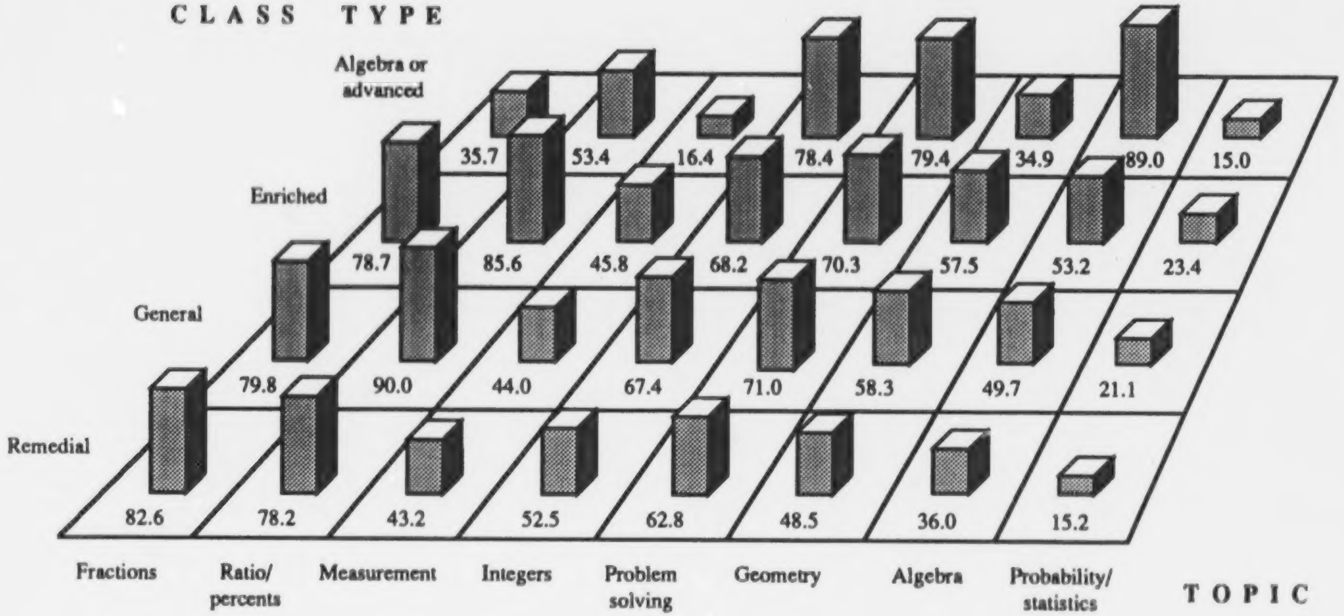
[23] C. McKnight et al., 1987.

[24] The choices offered for each subject were 1) major topic, 2) minor topic, 3) review topic only, and 4) not covered at all.

Figure 2.1--Percentage of 1988 eighth graders whose teachers reported covering various mathematics subjects as major topics, by type of class students reported attending



SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988, "Base Year Student and Teacher" surveys.

One way in which differences in the mathematics curriculum can be examined is to ascertain the extent to which teachers indicated that they taught algebra, one of the most advanced mathematics topics, compared with fractions, the most elementary topic. Use of these two topics, representing extremes in the mathematics curriculum, clearly demonstrates how students of varied backgrounds and communities differed in their exposure to such topics.

More than any other aspect of mathematics and science instruction, socioeconomic status was strongly associated with the types of mathematics topics covered in class. Only 49 percent of low-SES students were in mathematics classes where algebra was taught as a major topic, compared with 75 percent of high-SES students (table 2.5). Exactly the opposite pattern was seen for students in classes where the major topic was fractions: 79 percent of low-SES students were in such classes, compared with 52 percent of high-SES students.

Racial–ethnic group differences were also found in the NELS:88 survey. For example, Asian and white students were far more likely to be in mathematics classes where algebra was a major topic than were black students (67 percent of Asian students and 62 percent of white students, compared with 49 percent of black students). Not surprisingly, Asian and white students were also far less likely than black or Hispanic students to be in classes where fractions were covered as a major topic (approximately 80 percent of black and Hispanic students, compared with 55 percent of Asian students and 64 percent of white students).

Table 2.5--Percentage of 1988 public school eighth graders whose mathematics teachers reported covering algebra or fractions as major topics, by student background

	Algebra	Fractions
Total	62.0	64.3
Socioeconomic status		
Low	49.3	79.2
Moderate	59.1	68.1
High	74.8	52.4
Race–ethnicity		
Asian/Pacific Isl.	67.4	54.6
Hispanic	57.5	80.6
Black	48.5	80.4
White	62.3	63.8
American Indian/Alaskan Nat.	48.3	82.9

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Community and school attributes were also associated with the types of topics covered in mathematics classes (table 2.6). Nearly 70 percent of students in the Northeast were in mathematics classes where algebra was a major topic, compared with a little more than one-half of the students in the South and in the West. The opposite pattern was seen for the teaching of fractions: 59 percent of the students in the Northeast were in mathematics classes with fractions taught as a major topic, compared with more than 70 percent of the students in the South and in the West.

Table 2.6--Percentage of 1988 public school eighth graders whose mathematics teachers reported covering algebra or fractions as major topics, by community and school attributes

	Algebra	Fractions
Total	62.0	64.3
Region		
Northeast	69.4	59.2
North Central	64.3	64.0
South	54.4	73.2
West	53.5	71.3
Community type		
Urban	54.9	73.8
Suburban	64.9	63.9
Rural	56.2	69.1
Percent free lunch		
≤ 5 percent	72.1	58.8
6–20 percent	62.3	65.2
21–50 percent	52.5	69.6
> 50 percent	56.1	80.2
Student problems		
Serious	53.7	72.9
Moderate	61.1	66.7
Low	65.4	62.7
Teacher engagement		
Low	58.2	69.0
Moderate	58.5	67.6
High	68.5	65.3
Academic press		
Low	50.1	66.5
Moderate	63.4	70.3
High	63.0	63.5

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Suburban students, in general, had more exposure to algebra in their mathematics classes than did urban or rural students. For example, 65 percent of suburban students were in mathematics classes where algebra was taught as a major topic, compared with 55 percent of urban students and 56 percent of rural students.

There was some indication that students in schools with large free lunch programs (more than 50 percent receiving free lunches) studied algebra as a major topic less than those in schools with 5 percent or fewer students receiving free lunches. About 56 percent of the students in schools with large free lunch programs were in mathematics classes where algebra was taught as a major topic, compared with more than 72 percent of the students in schools with few students receiving free lunches (5 percent or less). At the same time, approximately 80 percent of students in schools with the largest free lunch programs were in mathematics classes where fractions were a major topic, compared with less than 60 percent in schools with few students receiving free lunches.

Topic Coverage in Science Classes

Eighth graders' science courses were generally classes that broadly covered many topics. As shown in table 2.7, earth science and weather/astronomy were taught as major topics to more than 50 percent of public school eighth graders. From 40 percent to 50 percent of the students studied topics related to environmental science or oceanography, chemistry, various physics subjects, and atomic theory. Fewer than one-quarter of eighth graders had teachers who covered subjects related to science in society, human biology or genetics, plants or animals, and personal health as major topics.

Table 2.7--Percentage of 1988 public school eighth graders whose science teachers reported covering various subjects as major topics

Total (for each mutually exclusive topic)	100.0
Earth science	57.2
Weather/astronomy	54.8
Environmental science/oceanography	47.9
Chemistry	46.1
Various physics subjects*	41.3
Atomic theory	41.6
Science in society	21.8
Human biology/genetics	18.6
Plants/animals	15.7
Personal health	9.2

*Electricity, mechanics, and heat or optics.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988, "Base Year Student and Teacher" surveys.

Class Size

More than one-half of public school eighth graders were in mathematics or science classes with 25 or fewer students. Eleven percent and 6 percent, respectively, of students were in math and science classes that had 15 or fewer students (tables 2.8a and 2.8b).

Table 2.8a--Percentage of 1988 public school eighth graders whose mathematics teachers reported classes of different sizes, by student background characteristics and geographic region

	Mathematics class size			
	1–15 pupils	16–25 pupils	26–30 pupils	More than 30
Total	11.3	45.9	30.0	12.9
Socioeconomic status				
Low	14.3	44.6	29.7	11.3
Middle	10.4	46.1	30.7	12.8
High	9.4	47.0	28.3	15.2
Race–ethnicity				
Asian/Pacific Isl.	9.3	31.8	29.4	29.5
Hispanic	7.0	36.5	37.4	19.1
Black	13.6	40.1	27.8	18.5
White	11.3	49.1	29.3	10.3
American Indian/Alaskan Nat.	22.9	33.5	32.0	11.7
Region				
Northeast	18.1	53.2	21.1	7.6
North Central	11.2	51.4	29.8	7.6
South	9.7	47.3	30.9	12.0
West	7.3	25.1	38.3	29.3

NOTE: Because of rounding errors, rows may not always add to 100 percent.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

An initially surprising result found in this study was that low-SES students were more likely than high-SES students to be in the smallest mathematics classes (classes with 15 or fewer students): about 14 percent of low-SES students were in mathematics classes of this size, compared with 9 percent of high-SES students (table 2.8a). While the difference was modest, it is statistically significant. The overrepresentation of low-SES students in the smallest mathematics classes may reflect a tendency on the part of mathematics teachers to place lower-achieving students in small groups for remedial instruction.[25] The same pattern held for the size of science classes (table 2.8b).

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[25] See L. Anderson and L. Pellicer, "Synthesis of Research on Compensatory and Remedial Education," *Leadership*, 1990, 10–15.

Table 2.8b--Percentage of 1988 public school eighth graders whose science teachers reported classes of different sizes, by student background characteristics and geographic region

	Science class size			
	1–15 pupils	16–25 pupils	26–30 pupils	More than 30
Total	5.6	45.3	36.3	12.8
Socioeconomic status				
Low	7.7	46.7	32.9	12.7
Middle	5.3	44.6	37.9	12.1
High	3.8	45.1	36.6	14.5
Race–ethnicity				
Asian/Pacific Isl.	5.7	36.7	33.9	23.7
Hispanic	5.6	37.1	39.3	18.0
Black	4.9	38.8	37.3	19.0
White	5.6	47.4	36.2	10.8
American Indian/Alaskan Nat.	5.4	56.7	26.5	11.4
Region				
Northeast	6.5	52.4	28.3	12.9
North Central	4.9	51.6	37.7	5.9
South	5.6	43.9	36.9	13.7
West	5.7	33.8	40.4	20.1

NOTE: Because of rounding errors, rows may not always add to 100 percent.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Differences were also observed among students of different racial–ethnic groups in relation to class size. For example, Asian students were more likely than white students to be in the largest mathematics classes (30 or more students). The same held for science classes. In addition to these differences, black students were more likely than Hispanic students to be in the smallest mathematics classes. These patterns of racial–ethnic distributions in classes may to some extent have been caused by regional differences. For example, western states are known to have the largest Asian and Hispanic populations and also to have the largest mathematics classes. Nearly 30 percent of students attending schools in the West were in mathematics classes with 30 or more students, compared with 12 percent or fewer in other regions.

Class Time Allocations

An important indicator of the quality of instruction received by students may be how class time is allocated to whole class instruction compared with small group or individual instruction. In this study, almost one-half (49 percent) of eighth-grade math students and 42 percent of science students spent 50 percent to 75 percent of their class time in whole group instruction. The amount of time that students spent learning as a whole group in mathematics classes differed for various groups of students. Low-SES students were less likely than high-SES students to be in classes taught primarily as a whole group (that is, they were more likely to be in classes where less than half the class time was spent learning as a whole group). For instance, 44 percent of low-SES students were in mathematics classes where less than 50 percent of the time was spent as a whole group, compared with only 33 percent of high-SES students (table 2.9a). Again, the prevalence of low-SES students in mathematics classes that spent less learning time as a whole group (and thus, more time in small groups and working individually) may indicate the widespread use of small groups for remediation.

Table 2.9a--Percentage of 1988 public school eighth graders whose mathematics teachers reported different allocations of whole group time, by student SES and geographic region of the school

	Amount of class time as whole group		
	<50 percent	50–75 percent	>75 percent
Total	39.7	48.6	11.7
Socioeconomic status			
Low	44.4	44.4	11.1
Middle	39.8	48.0	12.2
High	33.4	55.2	11.4
Region			
Northeast	23.9	60.5	15.6
North Central	37.4	52.1	10.5
South	45.1	41.1	13.8
West	48.4	46.7	4.9

NOTE: Because of rounding errors, rows may not always add to 100 percent.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

The pattern of class time allocation in relation to socioeconomic status as seen for mathematics classes was not observed for science classes (table 2.9b). Whereas spending more time in smaller groups in mathematics classes may signify increased remedial instruction, in science classes it may indicate increased participation in science experiments.

Table 2.9b--Percentage of 1988 public school eighth graders whose science teachers reported classes with different allocations of whole group time, by student SES and geographic region

	Amount of class time as whole group		
	<50 percent	50–75 percent	>75 percent
Total	43.0	42.0	15.1
Socioeconomic status			
Low	41.0	42.0	17.1
Middle	42.0	43.3	14.7
High	47.4	39.0	13.6
Region			
Northeast	30.2	52.2	17.6
North Central	41.7	46.7	11.6
South	39.6	40.5	20.0
West	62.1	29.8	8.1

NOTE: Because of rounding errors, rows may not always add to 100 percent.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Regional differences, however, were found suggesting that students attending schools in the West (62 percent) were more likely than those in other areas (42 percent or fewer) to be in science classes that spent less than 50 percent of class time as a whole group.

Amount of Homework Assigned

Math and science teachers were asked approximately how many hours of homework they assigned in their classes per week. Most students (65 percent of students in mathematics classes and 73 percent in science classes) had teachers who assigned from 1 to less than 3 hours of homework per week (table 2.10a). About 11 percent of students in science classes were assigned less than 1 hour of homework per week, compared with 6 percent of mathematics students. Likewise, 10 percent of students in mathematics classes were assigned more than 4 hours of homework, compared with 4 percent of science students.

Table 2.10a--Percentage of 1988 public school eighth graders with mathematics or science teachers who assigned different amounts of homework

	Math	Science
Hours of homework assigned per week		
Total	100.0	100.0
Less than 1	5.6	11.2
1 to less than 3	65.2	73.3
3 to 4	19.6	11.7
more than 4	9.6	3.8

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Different groups of students did not show a great deal of variation in the amount of homework their mathematics or science teachers assigned. However students in remedial math classes were more likely than students in other levels of classes (algebra/advanced, enriched, or general) to be assigned less than one hour of homework (table 2.10b).

Table 2.10b--Percentage of 1988 public school eighth graders whose mathematics teachers reported assigning various amounts of homework (hours/week), by class type

	Less than one	1 to less than 3	3 to 4	More than 4
Algebra				
Advanced	4.3	55.6	26.5	13.6
Enriched	5.4	67.1	17.3	10.2
General	5.5	70.0	17.3	7.1
Remedial	10.4	66.8	14.6	8.2

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Microcomputer and Calculator Access

Fewer than 40 percent of public school eighth graders in mathematics or science classes had any access to microcomputers (table 2.11). Even among those students whose teachers indicated that microcomputers were available, most were in classes where fewer than 10 percent of the students actually used them. About 10 percent of mathematics students participated in classes where more than one-quarter of the class had access to computers, compared with 6 percent of science students.

Table 2.11--Percentage of 1988 public school eighth graders whose mathematics or science teachers reported different access and use of microcomputers and calculators

	Math class	Science class
Microcomputer use		
Total	100.0	100.0
None	62.5	65.5
Fewer than 10% of students	21.1	22.4
10–25% of students	6.6	6.1
More than 25% of students	9.8	6.0
Calculator access		
Total	100.0	N/A
No	56.0	N/A
Yes	44.0	N/A
If access: How much:		
Total	100.0	N/A
Little access	41.4	N/A
Once/week	28.8	N/A
More than once/week	29.9	N/A

NOTE: Because of rounding errors, categories may not always add to 100 percent.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

In the National Survey of Practices and Trends conducted in the middle schools, 78 percent of school principals reported that mathematics teachers gave daily drills in computation. However, student use of calculators as a means of doing mathematics work was found to be infrequent.[26] The same appeared to be true for students in the NELS:88 survey where mathematics students' access to calculators was no more frequent than their access to microcomputers. Among those students whose teachers indicated that there was access to calculators (44 percent), the frequency of use was low (70 percent used them once a week or less).

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[26] H.J. Becker, "Curriculum and Instruction in Middle Grade Schools," *Phi Delta Kappan*, February 1990, 450–457.

Student Attitudes Toward Mathematics and Science

While nearly 90 percent of eighth graders thought that mathematics was important to their future, only 70 percent felt the same way about science. It is very interesting to note the pattern of student attitudes toward mathematics and science among students of different subgroups. Students of lower socioeconomic status (for mathematics only) and students who attended schools in which more than 50 percent of students received free lunches (for both mathematics and science) were more likely than students from more advantaged backgrounds (high-SES and low-poverty schools—20 percent or fewer receiving free lunches) to look forward to attending class (tables 2.12a and 2.12b). At the same time, low-SES students were more afraid to ask questions than those from more advantaged backgrounds. The difference between low-SES students and those in higher socioeconomic groups may be in the expectations teachers have of them. Teachers in schools with more advantaged student populations may be more demanding and expect more of their students than those in less advantaged schools. Hence, students in more advantaged schools may be less likely to look forward to the rigor of their classes than their more disadvantaged peers, but they may be more confident in their knowledge.

Another interesting finding is that white students did not share the same enthusiasm toward mathematics and science as did students in other ethnic groups. White students were less likely than Asians, Hispanics, and blacks to look forward to mathematics or science classes.

Table 2.12a--Percentage of 1988 public school eighth graders reflecting different attitudes toward mathematics, by student background and percent free lunch

	Attitudes toward class		
	Look forward to mathematics	Afraid to ask questions	Important to future
Total*	56.6	21.0	87.9
Socioeconomic status			
Low	61.8	23.7	87.9
Middle	55.5	20.4	87.6
High	52.7	19.0	88.3
Race–ethnicity			
Asian/Pacific Isl.	66.3	21.4	90.3
Hispanic	62.7	27.8	88.7
Black	72.0	20.8	89.0
White	52.6	19.8	87.5
American Indian/Alaskan Nat.	54.8	33.4	82.5
Percent free lunch			
≤ 5 percent	50.0	18.0	87.5
6–20 percent	53.6	20.6	86.8
21–50 percent	58.9	21.4	88.1
> 50 percent	66.0	24.6	90.1

* For consistency, the students in this table are only those whose mathematics teachers were surveyed.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 2.12b--Percentage of 1988 public school eighth graders reflecting different attitudes toward science, by student background and percent free lunch

	Attitudes toward class		
	Look forward to science	Afraid to ask questions	Important to future
Total*	62.7	14.7	69.4
Socioeconomic status			
Low	63.0	19.0	68.4
Middle	62.8	14.4	68.8
High	62.1	10.9	71.9
Race–ethnicity			
Asian/Pacific Isl.	68.6	14.3	76.5
Hispanic	67.3	20.5	70.6
Black	68.7	18.0	72.7
White	60.6	12.9	68.2
American Indian/Alaskan Nat.	69.7	31.7	77.0
Percent free lunch			
≤ 5 percent	59.5	13.3	68.1
6–20 percent	61.0	13.4	66.8
21–50 percent	64.0	15.3	70.2
> 50 percent	67.2	17.5	74.0

* For consistency, the students in this table are only those whose science teachers were surveyed.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Teacher Characteristics and Qualifications

In order to determine teacher qualifications, several aspects of their teaching background were examined. These included 1) highest degree earned, 2) subject of their baccalaureate degree, 3) number of years' teaching, and 4) teachers' self-assessment of how well prepared they were to teach their individual classes.

Virtually all of the eighth graders had mathematics and science teachers who had earned at least a baccalaureate degree. Less than one percent of public school eighth-grade students had mathematics or science teachers who had never completed a bachelor's degree, while approximately 46 percent had teachers who had earned a postgraduate degree (see figures 3.8a and 3.8b in the next chapter for breakdown by school type).

To determine the extent of subject-matter preparation that mathematics and science teachers had received, the subject of their baccalaureate major (and minor) was examined rather than their area of certification. This ensured relative consistency among teachers. Requirements for certification do vary from state to state and, in some cases, may have changed within states as the demand for mathematics and science teachers has increased.

Thus, even teachers within the same state may have been exposed to different criteria for certification.

Teachers' subject-matter preparation was characterized as follows: 1) whether or not they had majored in their teaching field; 2) if they had not majored in their teaching field, whether or not they had minored in it; 3) if they had neither majored nor minored in their teaching field, whether or not they had majored in education or another subject.

Approximately 49 percent of eighth-grade students had science teachers who reported majoring in science, while 43 percent of students had mathematics teachers who reported majoring in mathematics. About 70 percent of students had mathematics or science teachers who had either majored or minored in their field (math, 70 percent; science, 72 percent).

Eighth-grade students' backgrounds were related to the characteristics of their mathematics and science teachers (tables 2.13a and 2.13b). For example, students of high socioeconomic status were more likely than low-SES students to have mathematics teachers who had majored in mathematics (50 percent versus 39 percent). At the same time, low-SES students were more likely than high-SES students to have mathematics teachers (and to a lesser extent science teachers) who had majored in education.

Table 2.13a--Percentage of 1988 public school eighth graders whose mathematics teachers had different baccalaureate majors, by student background

	Major in mathematics/ math. education	Minor in mathematics/ math. education	Major in education only	Major in other subject only
Total	43.3	27.1	18.2	11.4
Socioeconomic status				
Low	38.5	25.9	23.1	12.6
Middle	43.2	27.7	17.7	11.4
High	49.8	26.2	13.2	9.8
Race–ethnicity				
Asian/Pacific Islander	44.1	23.5	15.0	17.5
Hispanic	33.3	28.5	17.5	20.8
Black	40.0	26.6	21.5	12.9
White	45.7	27.2	17.7	9.4
American Indian	30.5	23.5	23.4	22.6

NOTE: Because of rounding errors, rows may not always add to 100 percent.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88): "Base Year Student and Teacher" Survey, 1988.

Table 2.13b--Percentage of 1988 public school eighth graders whose science teachers had different baccalaureate majors, by student background

	Major in science/science education	Minor in science/science education	Major in education only	Major in other subject only
Total	48.6	23.5	15.6	12.3
Socioeconomic status				
Low	44.0	23.6	18.3	14.1
Middle	49.6	23.9	15.2	11.3
High	51.6	22.5	13.6	12.3
Race–ethnicity				
Asian/Pacific Islander	53.3	22.6	11.4	12.6
Hispanic	46.6	20.5	16.1	16.8
Black	48.9	19.6	18.5	13.0
White	48.6	24.2	15.5	11.7
American Indian	39.9	47.7	7.1	5.3

NOTE: Because of rounding errors, rows may not always add to 100 percent.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88): "Base Year Student and Teacher" surveys.

Some differences among students' racial or ethnic backgrounds in relation to their mathematics teachers' subject-matter preparation were also found. For example, white students were more likely than Hispanic students to have mathematics teachers with a baccalaureate degree in mathematics. The same effect, however, was not seen for science teachers.[27]

There were also regional differences with respect to teacher education between students attending schools in the Northeast or North Central areas and those attending schools in the West. A greater proportion of students in Northeast and North Central schools had mathematics teachers with baccalaureate degrees in mathematics (53 percent and 50 percent, respectively), compared with students in the West (31 percent) (tables 2.14a and 2.14b). At the same time, students who attended schools in the West were more likely than students in northern schools to have mathematics teachers who had majored in "other" subjects (25 percent compared with 8 percent and 11 percent, respectively). Whether a school was located in the city, suburb, or rural area was not significantly associated with the baccalaureate majors of mathematics or science teachers.

Finally, there were some differences noted for the extent of the free lunch program in relation to subject-matter preparation for mathematics teachers. Thirty-two percent of the students who attended schools with large free lunch programs (more than 50 percent receiving a free lunch) had mathematics teachers who had majored in mathematics, compared with 50 percent of the students attending schools with smaller programs (6 percent to 20 percent receiving free lunches).

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[27] Even though it appears that there are similar differences among students of different racial–ethnic backgrounds for science teachers' baccalaureate degrees, there was more variation among science teachers within each racial–ethnic category. Therefore, statistically significant differences were not observed.

Table 2.14a--Percentage of 1988 public school eighth graders whose mathematics teachers had different baccalaureate majors, by community and school characteristics

	Major in mathematics/ math. education	Minor in mathematics/ math. education	Major in education only	Other subject
Total	43.3	27.1	18.2	11.4
Region				
Northeast	52.6	26.8	13.0	7.7
North Central	49.8	23.5	15.8	10.9
South	39.0	28.8	22.4	9.9
West	30.6	27.0	17.7	24.7
Community type				
Urban	43.4	28.6	15.4	12.7
Suburban	41.7	27.3	16.5	14.5
Rural	45.3	26.0	22.1	6.6
Percent free lunch				
<= 5 percent	45.7	26.6	15.6	12.1
6–20 percent	49.7	26.2	14.0	10.1
21–50 percent	40.3	27.8	20.3	11.5
> 50 percent	31.8	26.1	24.1	18.2

NOTE: Because of rounding errors, rows may not always add to 100 percent.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 2.14b--Percentage of 1988 public school eighth graders whose science teachers had different baccalaureate majors, by community and school characteristics

	Major in science/ science education	Minor in science/ science education	Major in education only	Other subject
Total	48.6	23.5	15.6	12.3
Region				
Northeast	57.1	19.5	9.6	13.9
North Central	53.1	19.0	19.2	8.7
South	39.9	26.0	19.4	14.8
West	50.6	26.7	8.5	14.3
Community type				
Urban	53.3	19.9	10.8	16.1
Suburban	51.4	24.8	12.8	11.1
Rural	41.9	23.3	21.3	13.5
Percent free lunch				
<= 5 percent	48.8	23.8	17.2	10.3
6–20 percent	52.0	27.6	11.1	9.3
21–50 percent	49.6	21.3	17.3	11.8
> 50 percent	38.9	19.5	16.5	25.1

NOTE: Because of rounding errors, rows may not always add to 100 percent.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Educational Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Eighth-grade mathematics and science teachers in general were very experienced, with a majority of students having teachers who reported 10 or more years of experience. About 11 percent of students had relatively inexperienced mathematics teachers (3 years or fewer of teaching), and 12 percent had equally inexperienced science teachers. Some regional differences were observed for mathematics teachers. Those teachers in the South seemed to be somewhat less experienced than North Central teachers (table 2.15). Approximately 15 percent of southern students had mathematics teachers with 3 or fewer years of teaching experience compared with 5 percent of the students in the North Central region. No such statistically significant associations were found for science teachers.

Table 2.15--Percentage of 1988 public school eighth graders whose mathematics and science teachers had various years of teaching experience, by geographic region

	Number of years taught			
	1 to 3 years	4 to 9 years	10–18 years	GE 19 years
Mathematic teachers				
Total	11.2	19.0	37.0	32.9
Region				
Northeast	9.8	14.8	41.2	34.2
North Central	4.8	20.8	36.0	38.5
South	15.4	18.7	38.6	27.3
West	12.5	21.4	30.3	35.7
Science teachers				
Total	12.1	19.1	36.9	31.9
Region				
Northeast	7.7	11.8	35.5	45.0
North Central	12.3	11.7	41.2	34.8
South	10.3	26.3	39.9	23.4
West	19.1	21.1	26.9	32.9

NOTE: Because of rounding errors, rows may not always add to 100 percent.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Almost all teachers felt that they were very well or well prepared to teach. Science teachers felt, in general, less prepared than mathematics teachers to teach their respective fields. Only 84 percent of students had science teachers who felt well or very well prepared to teach their classes, compared with 97 percent of students with mathematics teachers who shared similar attitudes (table 2.16).

Table 2.16--Percentage of 1988 public school eighth graders whose mathematics and science teachers reported various levels of preparedness to teach

	Well to very well prepared	Adequately prepared	Somewhat or unprepared
Science teachers	84.0	12.0	3.7
Math teachers	96.6	2.9	0.5

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Chapter III

Mathematics and Science Instruction in Public and Private Schools

This chapter presents an overview of findings as they differ for public and private school students. In the NELS:88 survey, in addition to public schools, three types of private schools were identified: Catholic schools; private, nonreligious (independent) schools; and private schools that do not classify themselves as either independent or Catholic (primarily religious schools such as Lutheran, Fundamentalist Christian academies, Jewish schools, and so on). For ease of presentation, this report identifies the four types of schools as follows: public; Catholic; private, nonreligious; and other religious.

The following sections discuss several areas of mathematics and science instruction in which differences were found among the four school types.[28] The most prominent differences were found for mathematics and science curricula characteristics such as mathematics class type (or track) and exposure to science experiments. Mathematics and science class sizes also varied according to school type. More modest differences were found for classroom experiences including class time allocation and grouping, and the amount of homework assigned by mathematics and science teachers. In addition, modest differences were found for teacher qualifications, especially the subject in which teachers had earned their bachelor's degree.

Mathematics and Science Curricula

Class Types and Topic Coverage

Students who attended private, nonreligious schools were more likely than public or Catholic school students to report attending an algebra or advanced mathematics class (58 percent compared with 29 percent and 26 percent, respectively) (table 3.1). Catholic school students were more likely than students in other types of schools to report attending a remedial class, while public school students were more likely than private, nonreligious school students to report attending remedial classes.

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[28] Throughout this chapter differences among the various schools may appear quite large. However, due to the small samples of private nonreligious and private other religious school students, these differences are often not statistically significant (see appendix B for standard errors of the estimates presented).

Table 3.1--Percentage of 1988 eighth graders attending different types of mathematics classes, by type of school

	Algebra or advanced	Enriched classes	General classes only	Any remedial class
Total*	29.6	17.0	46.2	7.1
School type				
Public	29.0	17.1	47.1	6.8
Catholic	25.7	18.4	43.4	12.5
Private, other religious	45.1	17.3	33.0	4.6
Private, nonreligious	57.9	6.5	32.3	3.3

*For consistency, students included in this table are only those whose mathematics teachers were surveyed.
NOTE: Because of rounding errors, rows may not always add to 100 percent.

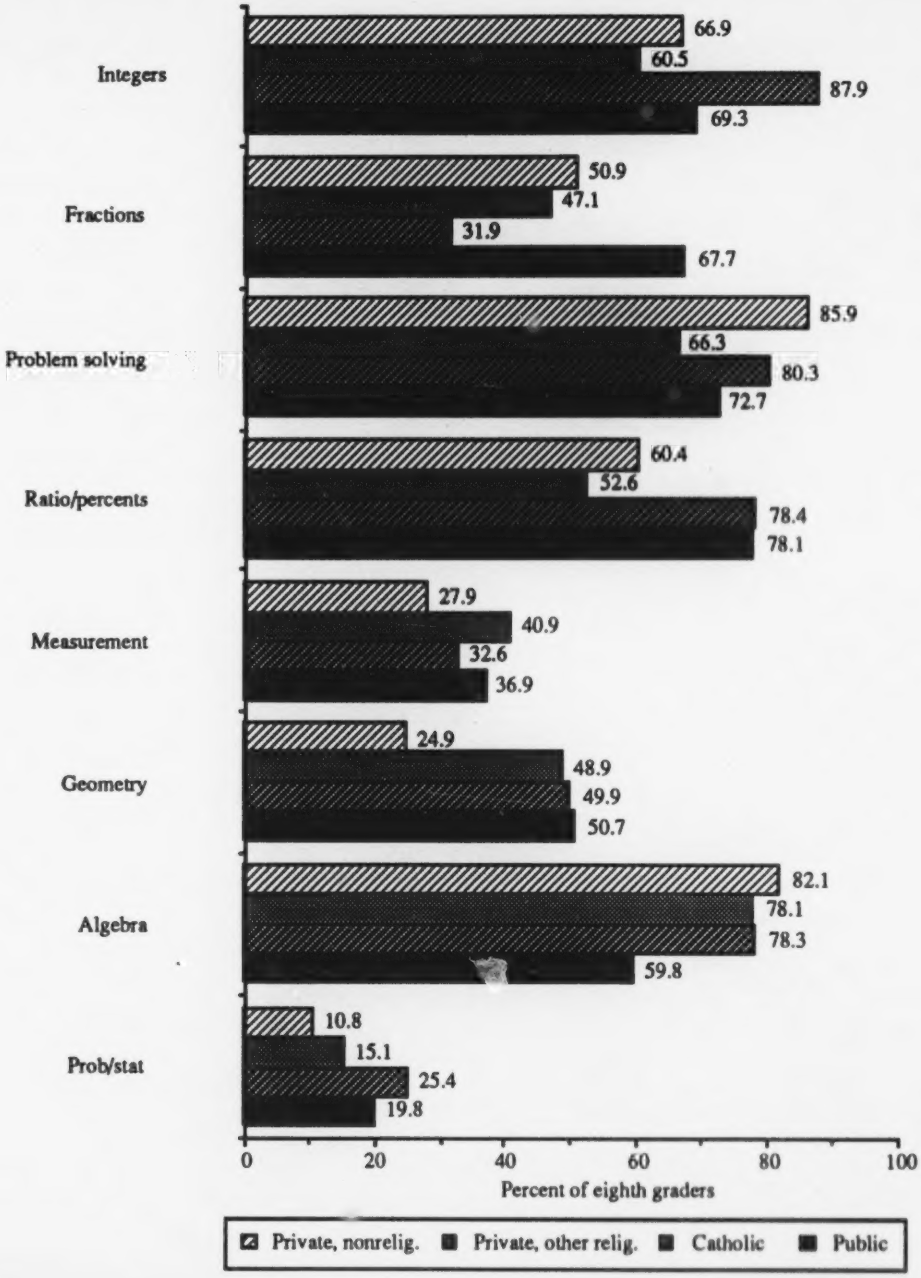
SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Survey of 1988 (NELS:88), "Base Year Student" survey.

In relation to topic coverage, public school students appeared to have less exposure to algebra than Catholic school students (figure 3.1). About 60 percent of public school students had teachers who reported that algebra was covered as a major topic in mathematics class, compared with 78 percent of Catholic school students. At the same time, a greater proportion of public school students than Catholic school students were in classes where fractions and decimals were taught (68 percent of public school students, compared with 32 percent of Catholic school students).

It is interesting to note that public and private schools differed with respect to the three most prevalent mathematics subjects covered as major topics. The subjects most frequently covered as major topics in public schools were ratios/percents, problem solving, and fractions. In private schools, however, the three most prevalent subjects covered as major topics were algebra, problem solving, and integers, which may indicate that private school students are exposed to more advanced mathematics subjects before entering high school than are public school students.

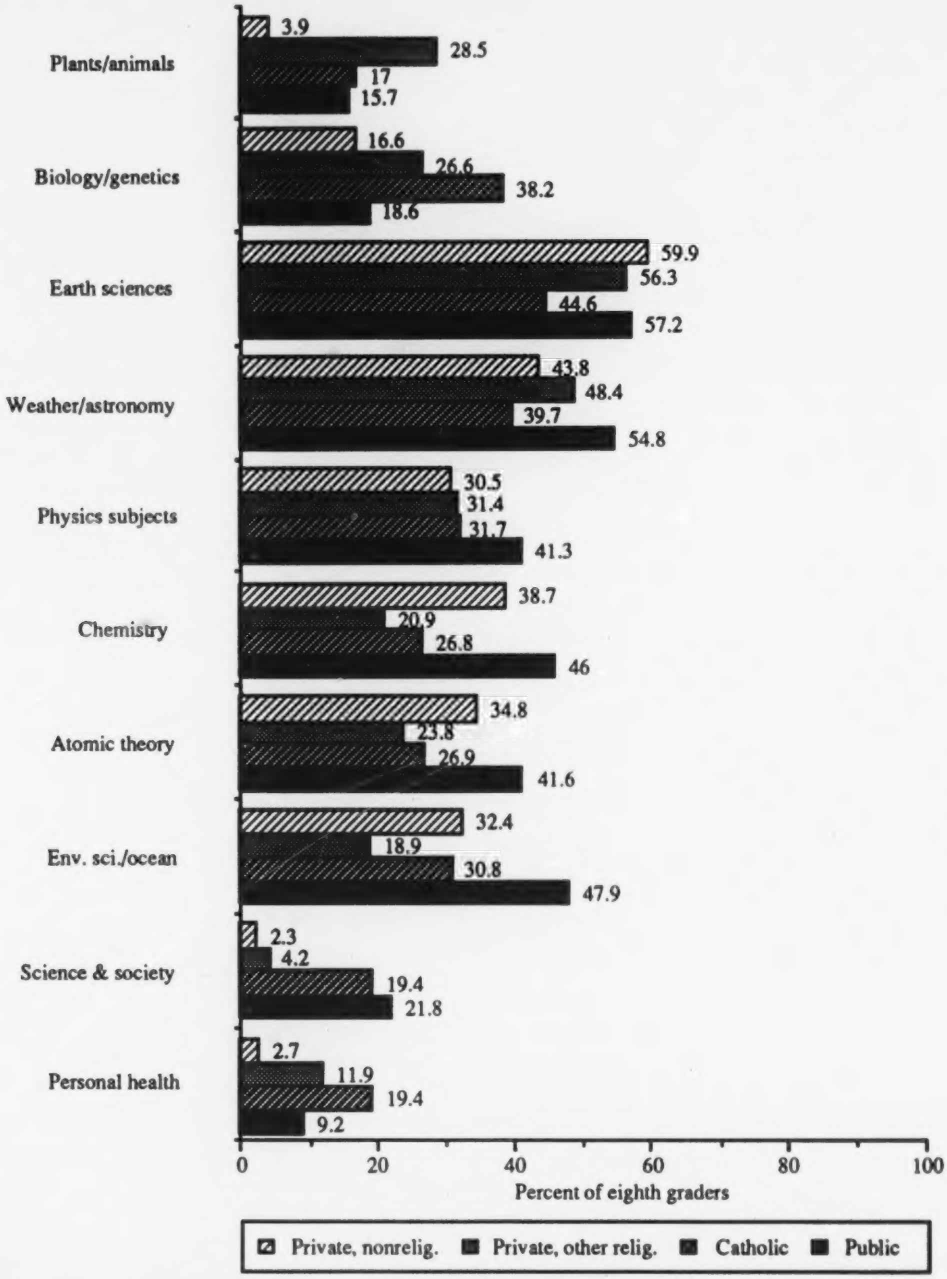
Differences in science topics covered were less obvious than those topics covered in mathematics. As shown in figure 3.2, earth science seemed to be the most prevalent subject taught, regardless of type of school, followed by weather and astronomy topics.

Figure 3.1--Percentage of 1988 eighth graders whose mathematics teachers reported covering various subjects as major topics, by type of school



SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Survey of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

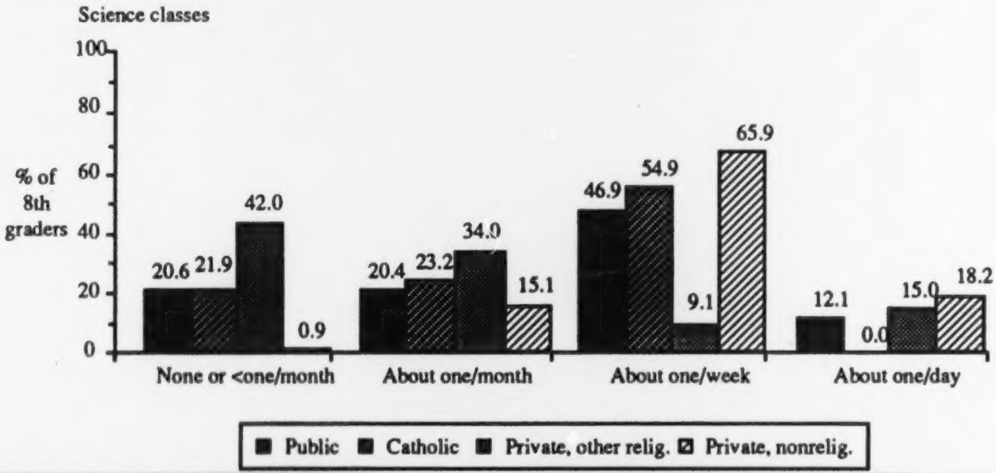
Figure 3.2--Percentage of eighth graders whose science teachers reported covering various subjects as major topics, by type of school



SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Survey of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Unlike science topic coverage, some differences were found in the levels of exposure to science experiments among students in different types of schools (figure 3.3a). Among students in private, nonreligious schools, only about one percent had teachers who reported conducting few science experiments (less than one per month), compared with 42 percent in private, other religious schools and about one-fifth in either public or Catholic schools.

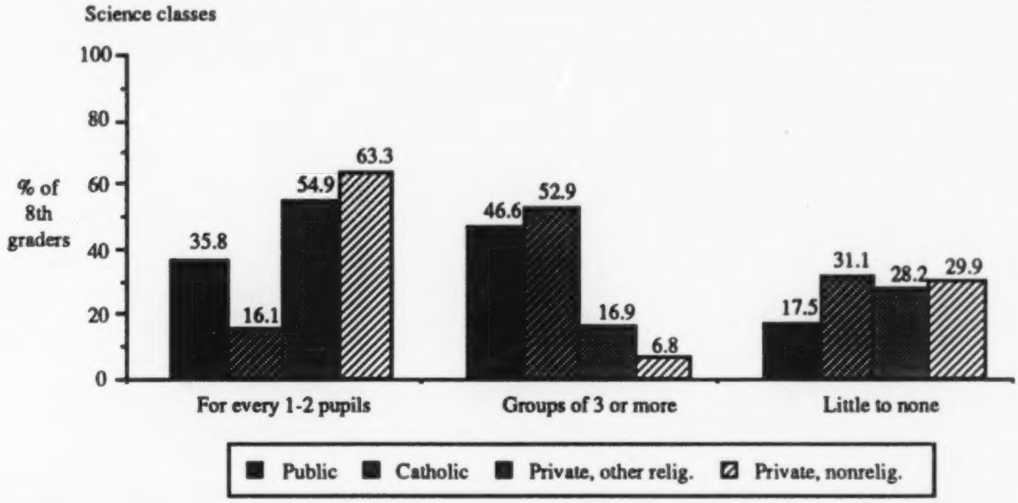
Figure 3.3a--Percentage of 1988 eighth graders whose science teachers reported varying frequencies of conducting scientific experiments, by type of school



SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Survey of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Private, other religious school students were less likely than students in any other school type to conduct frequent science experiments (weekly or daily). Only 9 percent of private, other religious school students had teachers who reported conducting weekly experiments compared with 66 percent, 55 percent, and 47 percent, respectively, of private nonreligious, Catholic, and public school students whose teachers reported the same. However, scarcity of scientific equipment did not explain how infrequently private, other religious school students conducted experiments, since only about one-third of these students were in classes where little to no equipment was available, and more than one-half were in classes where equipment was available for every one to two students (figure 3.3b).

Figure 3.3b--Percentage of 1988 eighth graders whose science teachers reported varying amounts of scientific equipment available, by type of school

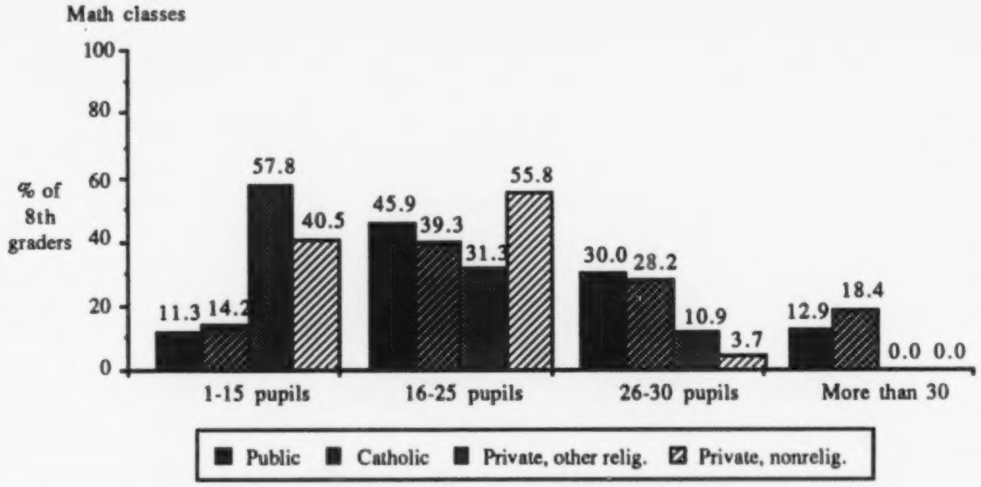


SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Survey of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Class Size and Time Allocation

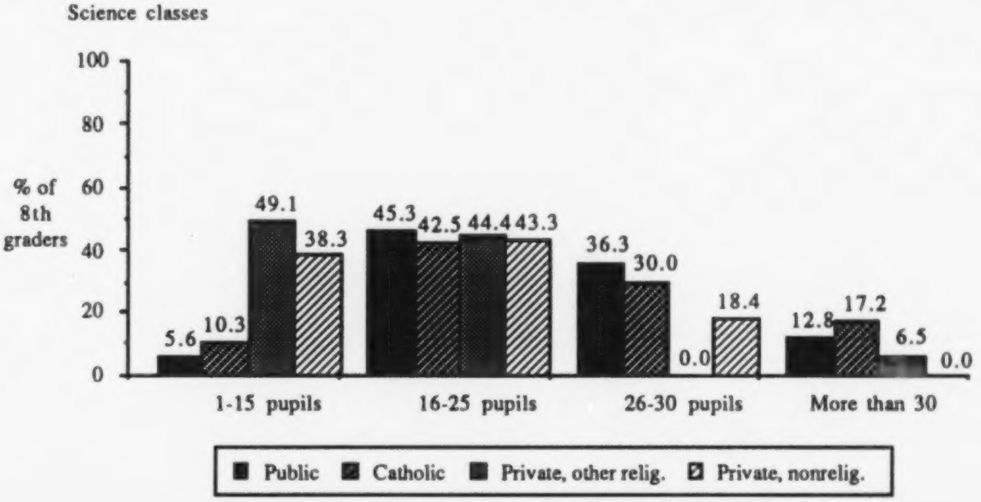
Students in private, other religious and nonreligious schools tended to have smaller mathematics and science classes than did students in either Catholic or public schools (figures 3.4a and 3.4b). More than one-half of private, other religious school eighth graders attended mathematics classes (58 percent) and science classes (49 percent) with 15 or fewer pupils. About 40 percent of private, nonreligious school students were also in mathematics and science classes with 15 or fewer students, compared with less than 15 percent of public and Catholic school students.

Figure 3.4a--Percentage of 1988 eighth graders whose mathematics teachers reported classes of various sizes, by type of school



SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Survey of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

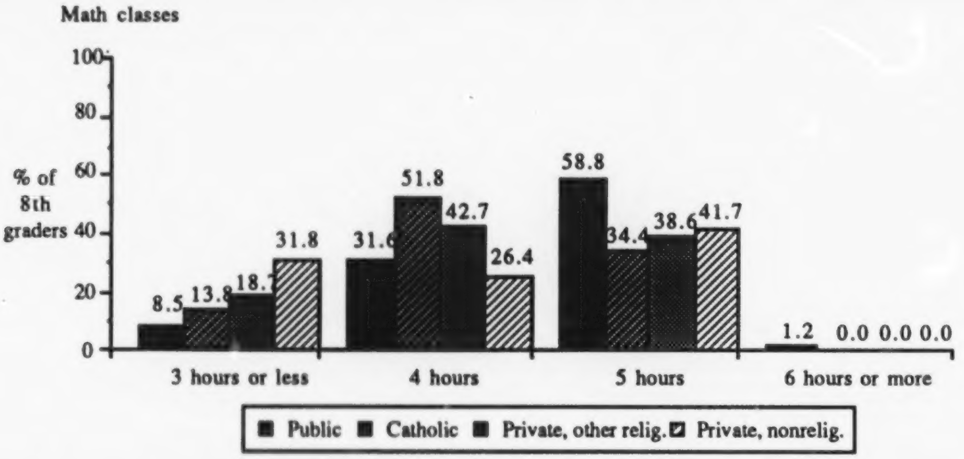
Figure 3.4b--Percentage of 1988 eighth graders whose science teachers reported classes of various sizes, by type of school



SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Survey of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Compared with public school students, private, nonreligious school students tended to participate more in mathematics classes that met for 3 or fewer hours per week (figure 3.5). For example, about 32 percent of eighth graders in private, nonreligious schools met for only 3 or fewer hours per week, compared with only 9 percent of public school students.

Figure 3.5--Percentage of 1988 eighth graders whose mathematics teachers reported classes of varying weekly duration, by type of school

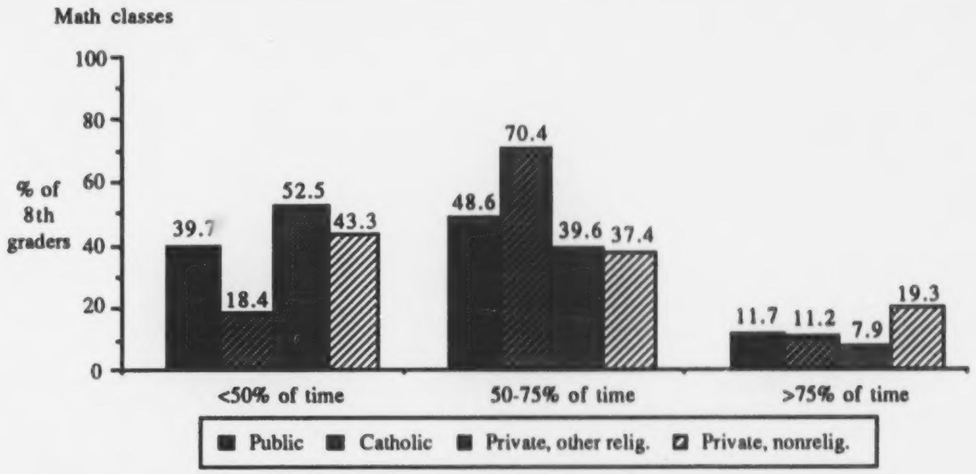


SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Survey of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

It was difficult to discern significant differences among school types in relation to time allocation to small groups and individual instruction. Schools of the same type appeared to vary markedly. Part of the reason this may be true is that many schools of the same type differ in class size. This factor may strongly affect how time, especially in small groups, is allocated. That is, if a class is small to begin with, there may be very little need for small group instruction and, perhaps, more time for individual instruction. Unfortunately, there were not enough private school students in the sample to control for class size.

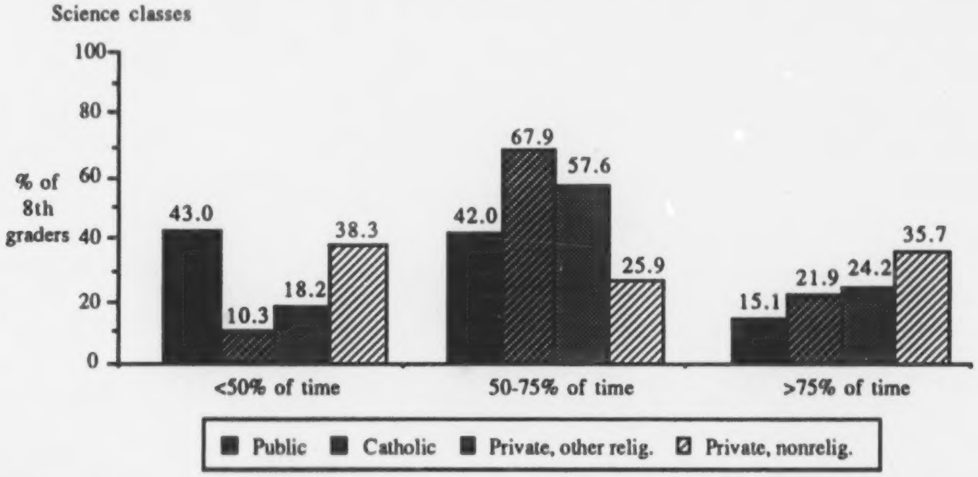
One way to examine patterns of time allocation is to determine how much time is spent teaching the class as a whole, rather than looking at small group and individual instruction time separately. For example, if a teacher spends less than 50 percent of class time teaching the entire class, the remainder is generally spent in small groups, individual instruction, or giving tests. Figures 3.6a and 3.6b illustrate the differences observed among types of schools for allocation of class time to the whole group in mathematics and science classes. From these figures, it appears that a smaller proportion of Catholic school students than public school students attended mathematics or science classes that met less than 50 percent of the time as a whole group. For example, only 18 percent of Catholic school students were in mathematics classes that met less than 50 percent of the time as a whole group, compared with 40 percent of public school students. Likewise, only 10 percent of these Catholic school students were in such science classes, compared with 43 percent of public school students.

Figure 3.6a--Percentage of 1988 eighth graders whose mathematics teachers reported classes with varying allocations of time spent as a whole group, by type of school



SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Survey of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Figure 3.6b--Percentage of 1988 eighth graders whose science teachers reported classes with varying allocations of time spent as a whole group, by type of school

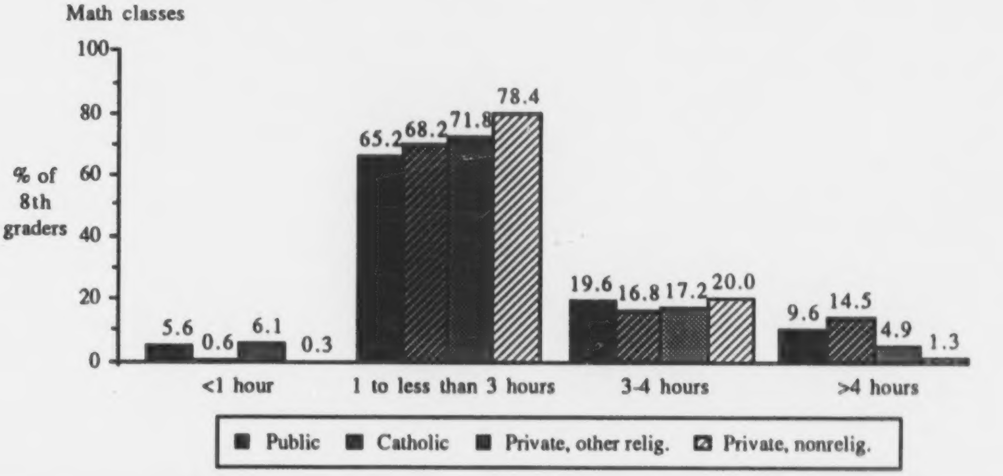


SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Survey of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Amount of Homework Assigned

A majority of eighth graders were assigned from 1 to less than 3 hours of mathematics and science homework per week. However, teachers in public schools were more likely to report assigning little homework (less than 1 hour/week) in mathematics than did teachers in Catholic or private, nonreligious schools (figure 3.7). For example, less than 1 percent of Catholic and private, nonreligious school students participated in mathematics classes where teachers assigned less than 1 hour of homework per week, compared with 6 percent of public school students.

Figure 3.7--Percentage of 1988 eighth graders with mathematics teachers who assigned varying amounts of weekly homework, by type of school

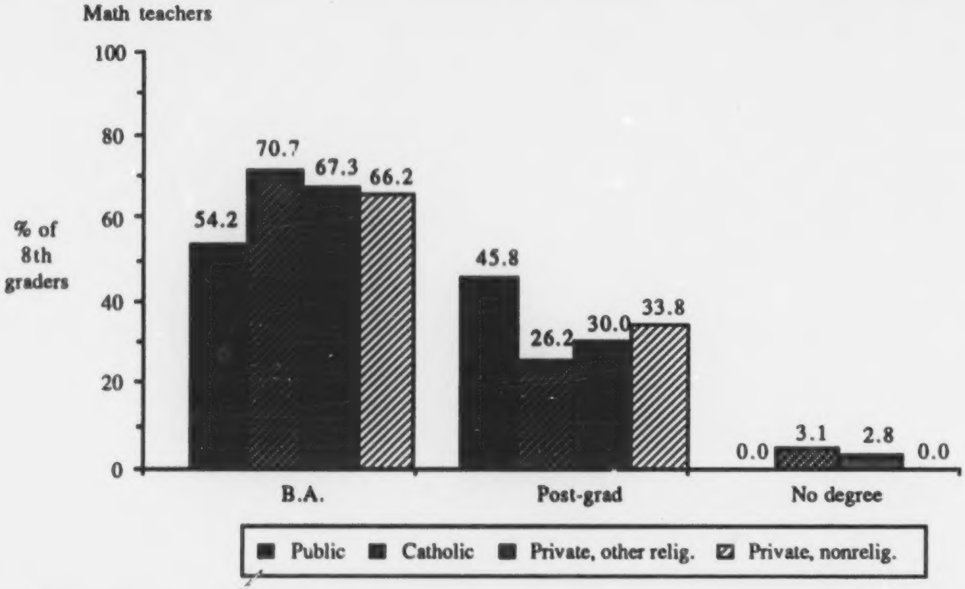


SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Survey of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Teacher Characteristics and Qualifications

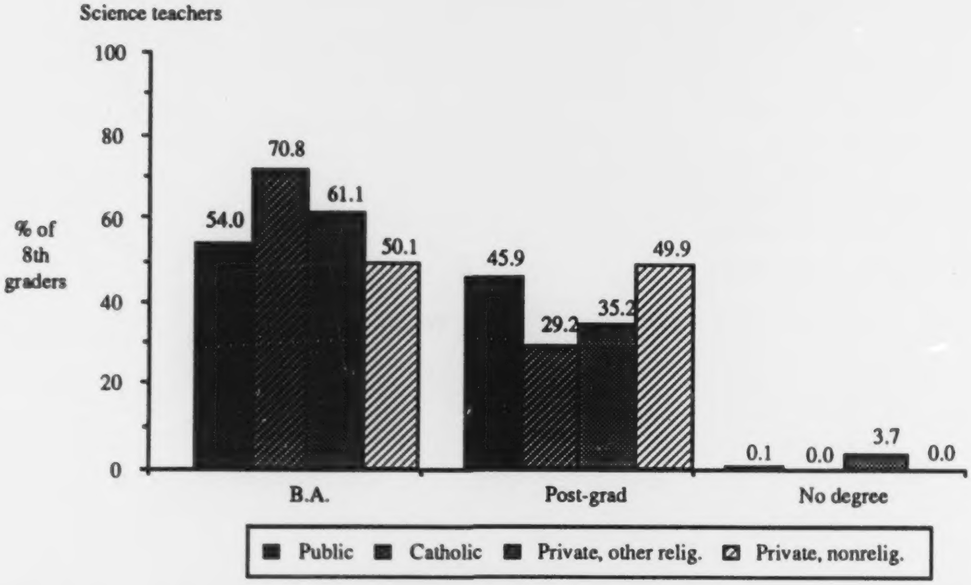
Virtually all the eighth-grade students' mathematics and science teachers included in the NELS:88 survey had earned at least a baccalaureate degree. For instance, less than 1 percent of eighth-grade students in public schools or private, nonreligious schools had mathematics or science teachers who had never completed a bachelor's degree. Public school students were somewhat more likely to have mathematics teachers who had postgraduate degrees than were Catholic school students (figure 3.8a). The percentage of science teachers earning baccalaureate and postgraduate degrees was similar to that of mathematics teachers, although no statistically significant school type differences were discerned (figure 3.8b).

Figure 3.8a--Percentage of 1988 eighth graders with mathematics teachers of various educational backgrounds, by type of school



SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Survey of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

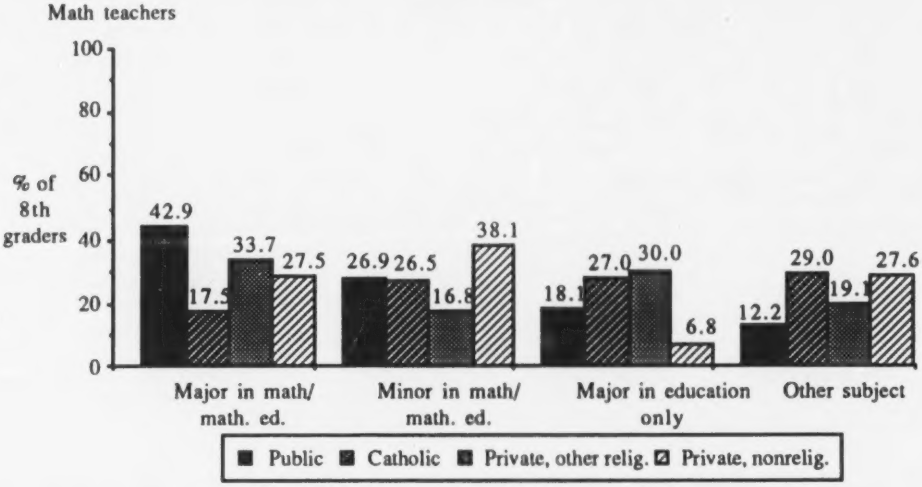
Figure 3.8b--Percentage of 1988 eighth graders with science teachers of various educational backgrounds, by type of school



SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Survey of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

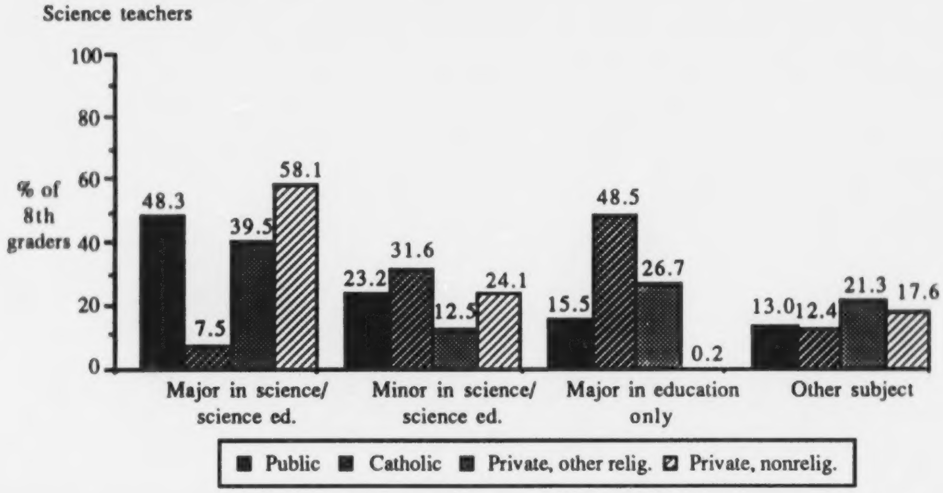
Differences in baccalaureate majors were observed among teachers in different types of schools (figures 3.9a and 3.9b). In mathematics, more public school students had teachers who had majored in their teaching field than students in Catholic schools. Among public school students, 43 percent had mathematics teachers who had majored in their teaching field. By contrast, only 18 percent of Catholic school students had mathematics teachers who had majored in mathematics. Fewer private, nonreligious school students had mathematics teachers who majored in education only than their counterparts in public schools (7 percent of private, nonreligious school students compared with 18 percent of public school students). Among science teachers, fewer than 1 percent of private, nonreligious school students had teachers who had majored in education only, compared with 49 percent in Catholic schools, 27 percent in private, other religious schools, and 16 percent in public schools.

Figure 3.9a--Percentage of 1988 eighth graders whose mathematics teachers had various baccalaureate majors, by type of school



SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Survey of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

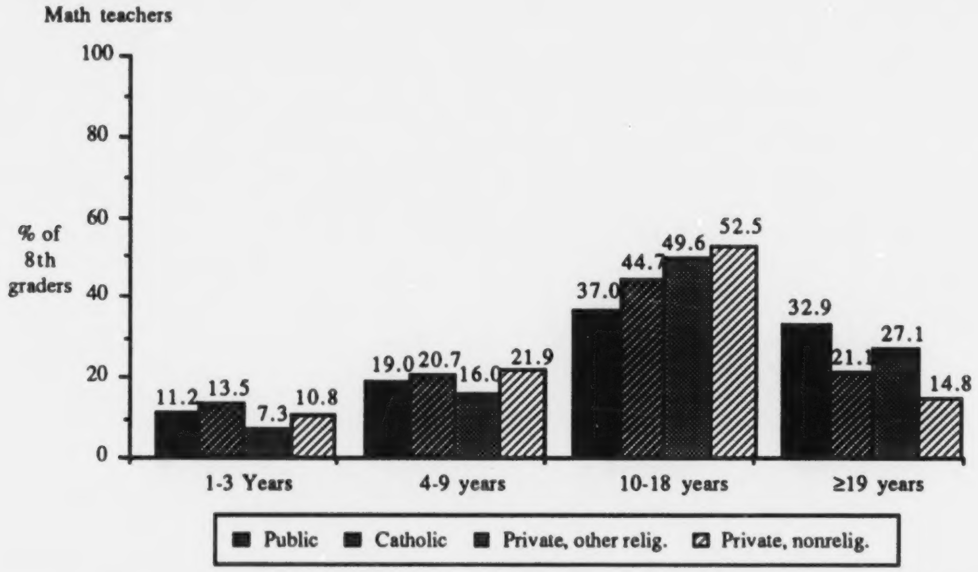
Figure 3.9b--Percentage of 1988 eighth graders whose science teachers had various baccalaureate majors, by type of school



SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Survey of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Mathematics and science teachers, in general, tended to be very experienced. Most students had teachers with 10 or more years of teaching experience. Regardless of the type of school attended, eighth graders' mathematics and science teachers had relatively similar amounts of teaching experience. Public school students, however, were more likely to have mathematics teachers with 19 or more years of experience (33 percent) than students in private, nonreligious schools (15 percent) (figure 3.10).

Figure 3.10--Percentage of 1988 eighth graders with mathematics teachers of varying teaching experience, by type of school



SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Survey of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Chapter IV

Mathematics and Science Achievement

In this chapter, mathematics and science achievement test scores are examined in relation to the various components of instruction that were measured in this study. Only differences that are statistically *and* practically significant (see appendix A for a more detailed discussion of the method) are discussed in the text.[29] Using this method, differences of about three or more points in scores are considered of practical significance, if the difference is statistically significant. The following four sections of this chapter present detailed findings for public school students, while the final section compares test scores for students in different types of schools.

Mathematics Curricula

Students who reported attending algebra or other advanced classes had, by far, the highest achievement test scores, while students who reported attending remedial classes had the lowest scores (table 4.1a). In addition, according to another report, students who were in algebra or other advanced mathematics classes were more than four times as likely as students in regular math classes to be proficient at high-level mathematics problem solving (42 percent versus 9 percent).[30] While it is true that high-ability students are more likely to be placed in algebra or other advanced mathematics classes, judgments about a student's ability may lead to early segregation of students into different class levels or tracks. Research suggests that the ways in which elementary schools define ability may reinforce students' own perceptions of their prospects for achievement.[31]

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[29] Readers should bear in mind that the achievement findings reported here are from cross-sectional data. Therefore, neither the direction of the associations nor causal relationships can be inferred.

[30] Rock, D. J. Pollack, and A. Hafner, *The Tested Achievement of 1988 Eighth Graders* (Washington, D.C., NCES-91460 report), 1991.

[31] J. Oakes, et al., *Multiplying Inequalities* (1990).

Table 4.1a--Average mathematics achievement test scores of 1988 public school eighth graders who reported attending various levels of mathematics classes

Total*	49.6
Mathematics class type reported by students	
Algebra/advanced	56.9
Enriched	46.4
General only	48.1
Any remedial	42.2

* For consistency, the average mathematics scores presented are for those students whose mathematics teachers were surveyed. These scores differed very little from the average for the entire student sample.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Educational Longitudinal Study of 1988 (NELS: 88), "Base Year Student and Teacher" surveys.

Students participating in mathematics classes where their teachers reported that algebra was covered as a major topic scored significantly higher than those in classes where other subjects (including ratios and percents, fractions, geometry, and measurement) were reported as major topics (table 4.1b). Students who were in mathematics classes where fractions or measurement were covered as major topics had lower scores than students who were in classes where teachers reported covering problem solving, integers, or probability and statistics as major topics.

Table 4.1b--Average mathematics achievement test scores of 1988 public school eighth graders whose mathematics teachers reported covering various subjects as major topics

Total	49.6
Subjects covered as major topics reported by teachers	
Ratios and percents	48.5
Problem solving	50.5
Integers	50.6
Fractions (common and decimals)	47.0
Algebra	52.7
Geometry	49.4
Measurement	47.3
Probability and statistics	50.4

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Educational Longitudinal Study of 1988 (NELS: 88), "Base Year Student and Teacher" surveys.

Science Curricula

There were obvious differences in the achievement levels of students who had various levels of exposure to science experiments. In a report by the American Association for the Advancement of Science on science literacy, one of the major recommendations for science education reform was to engage students more actively; that is, to give them the opportunity for "...collecting, sorting, and cataloging; observing, note taking, and sketching; interviewing, polling, and surveying; and using hand lenses, microscopes, thermometers, cameras, and other common instruments."[32] Innovative programs supported by the National Science Foundation have demonstrated that the benefits of hands-on science may be greatest for disadvantaged students.[33] In addition, this type of science education helps such students make greater gains in oral language and reading readiness than their peers who do not participate.[34]

The science achievement test scores shown in table 4.2 illustrate the fact that higher achieving students tended to be in science classes in which teachers reported conducting frequent experiments. Students in classes where experiments were conducted less than once a month had lower scores than students in classes where experiments were conducted weekly or daily.

Table 4.2--Average science achievement test scores of 1988 public school eighth graders whose science teachers reported varying exposure to scientific experimentation

Number of science experiments conducted	Science test scores
Total	49.9
None or less than one per month	48.0
About one per month	49.0
About one per week	50.8
Almost every day	51.6

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Educational Longitudinal Study of 1988 (NELS: 88), "Base Year Student and Teacher" surveys.

The relationship of student achievement level to the science subjects covered as major topics was not as obvious as that seen for mathematics. Students whose teachers reported covering chemistry as a major topic tended to score slightly higher on the achievement test in science than they did in some other topics (table 4.3). However, the only difference approaching practical (and statistical) significance was between classes where chemistry was covered as a major topic compared with those where personal health was covered as a major topic (score of 50.5 versus 48.1).

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[32] American Association for the Advancement of Science, *Science for All Americans* (a project 2061 report on the literacy goals in science, mathematics, and technology, AAAS publication no. 89-01S,, Washington, D.C., 1989, 147).

[33] *The Harvard Education Letter, "When Do Kids Do Science?"* 6(3) (1990).

[34] J. A. Shymansky, "What Research Says...about ESS, SCIS, and SAPA," *Science and Children* 26(7), (1989).

Table 4.3--Average science achievement test scores of 1988 public school eighth graders participating in science classes with various subjects covered as major topics

Total	49.9
Earth science	49.6
Weather/astronomy	49.5
Environmental science/oceanography	49.5
Chemistry	50.5
Various physics subjects*	49.9
Atomic theory	50.2
Science/society	49.3
Human biology/genetics	48.9
Plants/animals	49.5
Personal health	48.1

*Electricity, mechanics, heat, or optics.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Educational Longitudinal Study of 1988 (NELS: 88), "Base Year Student and Teacher" surveys.

Teacher Characteristics

Students' average mathematics and science standardized achievement test scores in relation to teacher education and experience are shown in table 4.4. There did not appear to be an association between highest degree earned by teachers and student achievement level in either mathematics or science. However students whose teachers majored in mathematics for their baccalaureate degree had a higher average score (51.1) than those whose teachers majored in either education (mean score of 47.1) or a non-mathematics subject (mean score of 47.4). The same relationship between teacher baccalaureate degree and student achievement was not found for science.

The number of years of teaching experience that students' mathematics teachers had tended to be somewhat associated with students' test scores. Students whose teachers had taught 10 or more years had an average score of 50.0, while students whose teachers had taught for 3 or fewer years had an average score of 47.5 (a difference that is statistically significant and approaching practical significance). The same relationship was not found for science teachers.

Table 4.4--Average mathematics and science achievement test scores of 1988 public school eighth graders in relation to teachers' education, teaching experience, and preparedness

	Mathematics scores	Science scores
Total	49.6	49.9
Highest degree earned		
Bachelor's	49.3	49.9
Post Graduate	49.9	50.0
No Degree	*	*
Bachelor's subject		
Majored in subject taught	51.1	50.0
Minored in subject taught	49.9	50.2
Majored in education†	47.1	49.0
Majored in other subject†	47.4	49.9
Number of years teaching		
1 to 3	47.5	49.2
4 to 9	49.2	49.6
10 or more	50.0	50.2

*Fewer than 50 students.

†Teachers fell into this category if mathematics teachers did not minor in mathematics and science teachers did not minor in science.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Educational Longitudinal Study of 1988 (NELS: 88), "Base Year Student and Teacher" surveys.

Classroom Characteristics

Classroom characteristics and their relationship to the level of student achievement are shown in table 4.5. It appears that students in small mathematics or science classes (1 to 15 students) had lower achievement test scores than did students in classes with 16 to 25 or 26 to 30 students.[35] This finding seems contrary to current beliefs about the benefits of small classes. However, there are indications that in public schools small groups may often consist of low-achieving students and are used for remedial instruction. For example, in a recent report, it was maintained that students in compensatory and remedial programs received instruction in smaller groups or classes and spent large amounts of time engaged in seat work activities.[36]

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[35] The sample of students in science classes with either 1 to 15 pupils or in classes with more than 30 students was too small to find a statistically significant difference between the average scores of students in classes of these sizes.

[36] L. Anderson and L. Pellicer, "Synthesis of Research on Compensatory and Remedial Education," *Education Leadership*, (September, 1990) 10–16.

Table 4.5--Average mathematics and science achievement test scores of 1988 public school eighth graders participating in mathematics and science classes of different sizes and various allocations of class time

	Mathematics scores	Science scores
Total	49.6	49.9
Class size		
1 to 15 students	46.9	47.1
16 to 25	50.1	50.3
26 to 30	49.6	50.1
More than 30	50.6	49.5
Hours/week class meets		
3 or fewer	50.7	51.8
4	50.8	50.1
5	48.9	49.3
6 or more	47.1	*

*Fewer than 50 students.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Educational Longitudinal Study of 1988 (NELS: 88), "Base Year Student and Teacher" surveys.

Another unusual finding is that students who were in mathematics or science classes that met for fewer hours a week (3 or fewer) scored higher on achievement tests than did students in classes which met for 5 or more hours a week (for science), or for 6 or more hours a week (for mathematics). A relatively small percentage of students were in classes that met for 3 or fewer hours (about 8 percent for math and 10 percent for science). It has also been reported that schools qualifying for Chapter 1 funding (primarily high-poverty schools) spend more time on mathematics and science.[37]

High mathematics achievement test scores tended to reflect students whose teachers assigned 3 to 4 hours of homework per week. As shown in table 4.6, these students scored higher than those in classes with less than 1 hour of homework assigned.[38]

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[37] J. Oakes (1990).

[38] The sample of students in classes assigned more than 4 hours of homework was too small to find a statistically significant difference between these students and those assigned less than 1 hour.

Table 4.6--Average mathematics and science achievement test scores of 1988 public school eighth graders whose teachers assigned different amounts of homework

	Mathematics scores	Science scores
Total	49.6	49.9
Hours of homework assigned per week		
Less than 1	48.2	48.5
1 to less than 3	49.6	50.5
3 to 4	51.9	50.8
More than 4	51.3	48.6

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Educational Longitudinal Study of 1988 (NELS: 88), "Base Year Student and Teacher" surveys.

Achievement Test Scores in Public and Private Schools

The type of school eighth graders attended was also associated with the achievement level of students in both mathematics and science (table 4.7).[39] In mathematics, students attending public schools had lower scores than eighth graders from any of the three types of private schools. The smallest difference (statistically significant and approaching practical significance) was between Catholic and public school students (average score of 52.3 compared with 49.6). Private, nonreligious students had higher scores than either Catholic or public school students. The differences for science were not as great, though private nonreligious school students scored higher (average score of 55.7) than public school students (average score of 49.9).

When interpreting these results, however, it is important to bear in mind that the student populations attending private schools are often very different from those in private schools. For example, in the NELS:88 survey, it is apparent that public schools serve much higher proportions of minority students, students with limited English proficiency, and students from single-parent families.[40]

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[39] These scores differ from those presented in another report published by NCES: E. Gareth Hoachlander, *A Profile of Schools Attended by Eighth Graders in 1988* (September, 1991). The scores in that report represented school-level averages rather than student-level averages.

[40] Ibid., 54.

Table 4.7--Average achievement test scores of 1988 eighth graders in different types of schools

	Mathematics scores	Science scores
Total*	50.1	50.2
Public	49.6	49.9
Catholic	52.3	51.5
Private, other religious	55.4	53.2
Private, nonreligious	57.8	55.7

* For consistency, the average mathematics scores presented are for students whose mathematics teachers were surveyed. Likewise, the science scores are averages for students whose science teachers were surveyed. These scores differed very little (e.g., not more than 0.8 points from the averages for the entire student sample).

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Educational Longitudinal Study of 1988 (NELS: 88), "Base Year Student and Teacher" surveys.

Chapter V

Summary and Conclusions

This study has presented a descriptive profile of mathematics and science instruction received by 1988 eighth graders.[41] A number of curricular and classroom characteristics thought to be important indicators of mathematics and science instruction were examined. These included mathematics class level; major topics covered in mathematics and science classes; exposure to scientific experimentation and resources available for science experiments; class size; time allocation and class grouping; and the amount of homework assigned. Moreover, several teacher characteristics were also examined such as education, especially their baccalaureate major; years of teaching experience; and the degree to which teachers felt prepared to teach their individual classes.

Mathematics Curriculum

With respect to curriculum, the major factors that characterized more advantaged and higher achieving mathematics students were the level of the mathematics class (that is, algebra/advanced classes as compared with general, or remedial classes) that students reported attending and exposure to algebra as reported by mathematics teachers. High-SES and high-achieving students were far more likely to report attending algebra or advanced classes than low-SES or lower achieving students. Students who reported attending these classes, however, accounted for only about one-third of eighth graders. A majority of students reported attending either general or remedial classes. In these classes, teachers reported covering a wide range of topics including fractions, ratios, problem solving, integers, and geometry, all with relatively equal intensity. These findings support those of the Second International Mathematics Study which found the American eighth-grade curriculum to be "arithmetic driven" with low intensity or emphasis on individual topics.[42] Those students who reported attending algebra or advanced mathematics classes, however, had teachers who reported covering algebra and problem solving as major topics with much less coverage of more elementary topics. Thus, not only were these students receiving instruction in more advanced topics, they were getting more intensive coverage of the topics being taught. While it is true that high-ability students are more likely to be in advanced classes, the distribution of students into different levels of classes is not always consistent, and there is often a great deal of overlap of ability within class levels.[43] Thus, an educator's evaluation of a student's ability in earlier years may prevent that student from getting the necessary preparation to study high-school level mathematics.

Science Curriculum

Because eighth grade science education is less clearly defined than mathematics, it is more difficult to characterize the eighth-grade science curriculum in terms of topics covered or the developmental level of the class. In the NELS:88 data, for instance, it is clear that the highest achieving students in mathematics study algebra with the greatest intensity. In science, however, there is less concentration in any one area. For example, the most prevalent topic covered in eighth-grade science classes was earth science. However, only 56 percent of the students attended classes in which their teacher reported covering earth science as a major topic. Moreover, student participation in classes where other subjects were covered as major topics ranged from 10 percent to 53 percent. There was one factor, however, that clearly distinguished higher achieving and more advantaged students, and that was the frequency with which science experiments were conducted. Those students who participated in "hands-on" classes where teachers reported conducting weekly or more frequent science experiments, were much more likely to score higher on the science achievement test, and also to be economically advantaged.

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[41] The data in this survey is cross-sectional only, therefore, while associations between instructional conditions and achievement are found, neither the direction of the association, nor causality can be inferred.
[42] C. McKnight, et al., 1987.
[43] Ibid.

Teacher Characteristics and Qualifications

The results of this study suggest that eighth graders' mathematics and science teachers are well educated and experienced. A majority of the eighth graders' teachers who were surveyed had at least a baccalaureate degree and many had post-graduate degrees. However, differences were found among various groups of students in relation to their mathematics and science teacher's baccalaureate major and teaching experience. For example, low-SES and minority students were more likely to have teachers who did not major in the subject they taught. In addition, these students were also more likely to have teachers who were less experienced (1 to 3 years of teaching).

Classroom Characteristics

More modest differences were observed among different groups of students for the other instructional conditions examined in this study. One such finding was that low-SES and minority students were more predominant in smaller mathematics classes and those where teachers devoted less than 50 percent of the time to whole-group instruction. This may indicate that smaller classes or small groups within classes focus more on remedial tasks than on inquiry-oriented activities.

Classroom resources such as calculators and computers were used by only a small percentage of eighth-grade students. For example, more than 60 percent of students in mathematics or science classes had no access to microcomputers. Even in classes where students had access, few students actually used the computers. Similarly, only about 44 percent of students participated in mathematics classes where calculators were used and among these students, only about one-third used them more than once a week.

School Type Differences

The mathematics curriculum of students attending private, nonreligious schools tended to include more algebra and less instruction in more elementary topics such as fractions than did the curriculum of public school students. For example, about 58 percent of private, nonreligious school students reported attending algebra or advanced mathematics classes, compared with only 29 percent of public school students. While similar proportions of Catholic and public school students reported attending algebra or advanced mathematics classes, the teachers of Catholic school students reported covering algebra as a major topic more than did public school teachers.

Within the science curriculum, a greater percentage of private, nonreligious school students were in science classes where teachers reported conducting experiments frequently (weekly or more) than students in private, other religious schools. In fact, students in private, other religious schools appeared to have the least exposure to scientific experimentation (three-quarters attended classes where experiments were conducted once a month or less).

A few differences among school types in relation to teacher characteristics were found in this study. For example, students attending public schools were more likely to have mathematics teachers who had majored in mathematics than did Catholic school students. Catholic school students, on the other hand, were more likely to have mathematics or science teachers who had majored in education only (almost one-third) than private, nonreligious school students (less than 7 percent).

Opportunity to Learn

Finally, the results of this study support the research of Oakes and others who have found consistent evidence of unequal opportunities to learn mathematics and science in American schools.[44] In the NELS:88 survey, low-SES and minority students were much more likely to report attending remedial mathematics classes and were much less likely to report attending science classes where frequent experiments were conducted. In addition, this analysis indicated that there was a disproportionate number of low-SES and racial minority students who had mathematics and science teachers with the least amount of experience (teaching no more than three years) and who were less likely to major in the field they taught.

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[44] J. Oakes, 1990.

Appendix A

Methodology and Technical Notes

Sample Design

The NELS:88 base year study employed a two-stage, stratified random sample design.[45] The population of schools was restricted to "regular" public and private schools with eighth graders in the United States. Excluded from the sample were Bureau of Indian Affairs (BIA) schools, special education schools for the handicapped, area vocational schools that do not enroll students directly, and schools for dependents of U.S. personnel overseas.

In the first stage of the sampling process, 1,052 schools with eighth grades were used for the NCES-sponsored core sample. In order to ensure a balanced sample, schools were stratified by region, urbanicity, and minority percentage prior to sampling. To make the sample more useful for policy analysis, private schools were oversampled. Just under 70 percent of the sample schools are original selections, while 30.4 percent are replacement schools (schools drawn from the sampling stratum to replace an initial selection that refused).

The second stage of the sampling process was the selection of students within schools. In this stage, students who were judged by a representative from the school as unable to complete the survey instruments were identified. Specifically, students identified as mentally handicapped, having physical or emotional problems that would seriously interfere with their ability to complete the survey instruments, or having a language barrier interfering with their completion of the survey instruments were excluded from the sample. About 5.4 percent of the potential sample was excluded for these reasons. Of those students who were excluded, a majority (57%) were excluded for reason of mental disabilities, with most of the rest (35%) excluded for language reasons, and a small number excluded because of physical disabilities (8%). Again for policy analysis reasons, students of Hispanic or of Asian or Pacific Islander (A/PI) origin were oversampled. This oversampling was sponsored by the Office of Bilingual Education and Minority Language Affairs (OBEMLA). On average, 26 students were sampled per school. This two-stage process resulted in the inclusion of over 26,000 eighth graders in the sample.

Teachers and school administrators also participated in NELS:88. Teachers were selected on a pre-assigned basis in two of four subject areas—mathematics, science, English, social studies (history/government). Each school was randomly assigned to one of the following combinations of curriculum areas: mathematics and English; mathematics and social studies; science and English; and science and social studies. At any school, each sampled student's current teacher(s) in each of the two designed subject areas was selected to receive a teacher questionnaire. This selection procedure was designed to ensure representation of mathematics or science curriculum and English or social studies in all schools. Using this design, the number of teacher respondents was expected to vary depending on the size and structure of the eighth grade at a particular school. An average of five teachers per school participated. Over 5,000 teachers filled out student-specific evaluations for a total of 23,188 sample students. While the teachers were not selected as a representative sample, their evaluations of sample students are linked to the specific student records, as are parent and school administrator reports. Finally, the school administrator (principal or headmaster) of each sample school was asked to complete a school administrator questionnaire. A total of 1,035 school administrators completed school questionnaires.

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[45] U.S. Department of Education, NCES, B. Spencer et al., "National Education Longitudinal Study of 1988 (NELS:88) Base Year Sample Design Report" (1990).

Data Limitations

The target population for the base year survey consisted of all public and private schools containing eighth grades in the 50 states and the District of Columbia. Excluded from the sample were Bureau of Indian Affairs (BIA) schools, special education schools for the handicapped, area vocational schools that do not enroll students directly, and schools for dependents of U.S. personnel overseas. In addition, students excluded from the sample included those with severe mental handicaps, students whose command of the English language was not sufficient for understanding the survey materials, and students with physical or emotional problems that would make it unduly difficult for them to participate. Given these limitations, users of NELS:88 data should exercise caution in interpreting findings for certain groups. For example, it is estimated that approximately 10 percent of American Indian children attend schools that are affiliated with the BIA. Thus, the estimates for this subpopulation may not be representative.

In this analysis, data from both the student and the teacher components of the survey were used. The teacher component of the NELS:88 survey, however, does not constitute a nationally representative sample of eighth grade teachers. NELS:88 teachers were not independently selected and their inclusion in the sample depended upon their linkage to a student who was selected for the survey. Therefore, in this study the student is the basic unit of analysis: the mathematics and science instruction characteristics were analyzed in relation to student-teacher pairs. Approximately half of the students surveyed had a math teacher surveyed (11,414), while the other half had a science teacher surveyed (10,868). Overall, approximately 91 percent of the students surveyed had either a math or science teacher surveyed.

The mathematics instruction component of this study is based upon only those students whose math teacher was surveyed, while the science instruction component was based upon only those whose science teachers were surveyed. Since the teachers were randomly assigned at the school level, the students had an equal probability of having either a math or science teacher surveyed, and thus, each group should be equally representative.

Accuracy of Estimates

The statistics in this report are population estimates derived from the sample described in the preceding section. Two broad categories of error occur in such estimates: sampling and nonsampling error. Sampling error occurs because samples are not populations. However, the nature of the error depends upon the sample design, and the error properties of many types of sample designs (including two-stage designs such as the one used in this study) are known. Nonsampling error occurs not only in sample surveys but also in population censuses.

Nonsampling error may arise from a number of sources, such as the inability to obtain cooperation from each sampled school (school nonresponse), or the inability to obtain information from each sampled student in cooperating schools (student nonresponse). A third source of nonresponse contributing to nonsampling error is found at the item level. Cooperating students may not have answered every question in the survey. In addition, ambiguous definitions, differences in interpreting questions, inability or unwillingness to give correct information, mistakes in recoding or coding data, and other errors of collecting and processing the data can result in nonsampling error.

The precision with which one can use survey results to make inferences to a population depends upon the magnitude of both sampling and nonsampling errors. In large sample surveys, such as the NELS:88 study, sampling errors are generally minimal, except when estimates are made for relatively small subpopulations, such as for American Indians (N=315).

The nonsampling errors are more difficult to estimate. The major sources of nonsampling error considered were school, student, and item-level nonresponse. The NELS:88 base year student response rate was above 93 percent and the item response rates within instruments, for the items used to develop the estimates in this report, were above 95.3 percent. The weights used to calculate the estimates were constructed in a fashion that compensated for instrument nonresponse. Weighting procedures are explained in the *NELS:88 Base Year Student User's Manual.*[46] The small bias due to nonresponse is documented in the *NELS:88 Base Year Sample Design Report.*[47]

Statistical Procedures

The statistical comparisons in this report were based on the **t** statistic. Generally, whether the statistical test is considered significant or not is determined by calculating a **t** value for the difference between a pair of means or proportions and comparing this value to published tables of values at certain critical levels, called alpha levels. The alpha level is an *a priori* statement of the probability of inferring that a difference exists when in fact it does not.

In order to make proper inferences and interpretations from the statistics, a number of issues must be kept in mind. First, comparisons resulting in large **t** statistics may appear to merit special attention. This is somewhat misleading, since the size of the **t** statistic depends not only on the observed differences in means or percentage being compared but also on the number of respondents in the categories used for comparison, and on the degree of variability among respondents within categories. A small difference compared across a large number of respondents could result in a large **t** statistic. Second, when multiple statistical comparisons are made on the same data it becomes increasingly likely that an indication of a population difference will be erroneously given. Even when there is no difference in the population, at an alpha-level of .05 there is still a 5 percent chance of declaring that an observed **t** value representing one comparison in the sample is large enough to be statistically significant. As the number of comparisons increases, the risk of making such an error in inference also increases.

To guard against errors of inference based upon multiple comparisons, the Bonferroni procedure to correct significance tests for multiple contrast was used. This method corrects the significance (or alpha) level for the total number of contrasts made with a particular classification variable. For each classification variable, there are (K*(K-1)/2) possible contrasts (or nonredundant pairwise comparisons), where K is the number of categories. For example, since SES has four categories, K=4 and there are (4*3)/2=6 possible comparisons between the categories. The Bonferroni procedure divides the alpha-level for a single **t** test (for example, .05) by the number of possible pairwise comparisons to give a new alpha that is corrected for the fact that multiple contrasts are being made.

Standard errors for the estimates in each of the tables are presented in the appendix. The standard errors were calculated using the STRATTAB program, which uses a Taylor series approximation to calculate standard errors based upon complex survey designs.[48] A version of this program is available from NCES upon request. The standard errors reported take into account the clustering in the sampling procedure; they are generally higher than standard errors calculated under the assumptions of simple random sampling.

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[46] U.S. Department of Education, NCES, S. Ingels et al., "NELS:88 Base Year Student Component Data File Users Manual" (1990).

[47] Spencer et al. (1990).

[48] C. Ogden, "StratTab User's Guide," MPR Associates (1989).

Interested readers can compute the **t** statistic between estimates from various subgroups presented in the tables using the following formula:

$$t = \frac{P1-P2}{SQRT\ (sel * sel + se2 * se2)}$$

where P1 and P2 are the estimates to be compared and se1 and se2 are their corresponding standard errors.

Effect size (used in Chapter 4) shows the mean difference in terms of standard deviation units. Effect sizes were calculated by subtracting the two mean estimates being compared and dividing by the total standard deviation. The use of effect size allows one to compare mean differences among groups even when the tests are on different scales. In addition to allowing for scale-free comparisons, the effect size yields an estimate of the size of the difference that is unaffected by the sample size. While many contrasts will be statistically significant given the large sample sizes, only a few may reach practical significance. Effect sizes in the .10 to .20 of a standard deviation range are considered small. Effects sizes between .3 and .5 of a standard deviation are considered to be in the "medium" effect size range and to be practically significant.[49] Effect sizes that approach a full standard deviation are considered quite large effects. Using the standardized formula score in this report, we know that the mean is 50 and standard deviation is 10, thus we consider any difference in effect sizes of 3 points or more (.3 of a standard deviation) to be statistically and practically significant.

Variables Used

Classification variables were selected to describe student characteristics such as sex, race–ethnicity and socioeconomic status; school characteristics such as region, urbanicity, and school type; and mathematics or science class characteristics such as class type, and test quartiles for each student. Most of these variables were taken directly from the student data file. The following classification variables were used in this report. The names in parentheses are the variable names that appear on the public use tape if different from the label.

Classification variables

Weight (BYQWT)

Calculated from the design weight (RAWWT) for the student questionnaire adjusted for the fact that some of the selected students did not complete the questionnaire.

Sex

(Male/female) was taken first from the student questionnaire (item 12). If this source was missing or not available, then the sex variable from school rosters was used. Any records with this variable still missing had sex imputed from the respondent's name, or if that could not be done unambiguously, the value for sex was randomly assigned for the purpose of constructing this composite.

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[49] Cohen and Cohen, *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences.* New York: John Wiley (1975).

1=Male
2=Female

Race

Also was constructed from several sources of information. The first source was the student self-report (item 31A). Secondly, if the student information was missing, data from the parent questionnaire were used. A small percentage of students who used the American Indian/Alaskan Native category but whose parents responded "white not Hispanic" were recoded to "white, not Hispanic" after a subsample of the parents was interviewed as a further check of the validity of student responses. The race categories are Asian/Pacific Islander; Hispanic, regardless of race; Black, not of Hispanic origin; white, not of Hispanic origin; and American Indian or Alaskan Native. Although identification as members of different Hispanic and Asian/Pacific Islander racial–ethnic subgroups was reported by students, these subgroup percentages are not presented in this report.

1=Asian or Pacific Islander
2=Hispanic, regardless of race
3=Black, not of Hispanic origin
4=White, not of Hispanic origin
5=American Indian or Alaskan Native

SES (BYSESQ)

(Socioeconomic status) was constructed using the following parent questionnaire data: father's educational level, mother's educational level, father's occupation, mother's occupation, and family income (data coming from parent questionnaire items 30, 31, 34B, 37B, and 80). Educational-level data were recoded as for the composite **PARENT EDUCATION.** Occupational data were recoded using the Duncan SEI scale as used in HS&B. Each non-missing component was standardized to a mean of 0 and a standard deviation of 1. Non-missing standardized components were averaged, yielding the SES composite.

For cases where all parent data components were missing (8.1 percent of the participants), student data were used to compute the SES. The first four components from the student data are the same as the components used from parent data (in other words, education-level data, items 34A and 34B, similarly recoded; occupational data, items 4B and 7B of student questionnaire part one, also recoded). The fifth component for SES from the student data consisted of summing the non-missing household items listed in 35A-P (after recoding "Not Have Item"), calculating a simple mean of these items, and then standardizing this mean. If eight or more items in 35A-P were non-missing, this component was computed; otherwise it was set to missing. All components coming from the student data were standardized. Non-missing standardized components were averaged, yielding the SES composite for those cases where parent data were either missing or not available. The student data were used to construct SES if all components based on parent data were missing and at least one component based on student data was not missing. Otherwise SES was set to missing. The actual range for SES is -2.97 through 02.56. SES is divided into quartiles, with 1 = lowest and 4 = highest. In this report the middle two quartiles were collapsed.

1=Highest 25%
2=Middle 50%
3=Lowest 25%

School type (G8CTRL)

Classifies the school into one of four sampling strata of public, Catholic, independent (private, non-religious), or other private (religious other than Catholic). Some of this information was taken directly from the QED file. QED is a standard school universe file maintained by Quality Education Data, and correlates well with the Common Core of Data maintained by the U.S. Department of Education. The list used for sampling independent schools was the membership list of the National Association of Independent Schools.

The second scheme classified schools into public, Catholic, religious other private, and non-religious other private. This classification appears on the NELS:88 base year public-use files. In the two schemes, the public and Catholic school categories are the same, but the remaining private school categories contain somewhat different mixes of schools.

1=Public school
2=Catholic school
3=Private, other religious affiliation
4=Private, no religious affiliation

Location or urbanicity (G8URBAN)

Categorizes the students' schools as urban, suburban or rural based on their classification in QED, as drawn from U.S. Census data and definitions. Urban means central city; suburban is the area surrounding a central city but within a county constituting the MSA (or Metropolitan Statistical Area); and rural is outside the MSA.

1=Urban, central city
2=Suburban, area surrounding a central city within a county constituting the MSA
3=Rural, outside MSA

Percent minority (G8MINOR)

Reflects the percentage of minority students in the eighth grade reported by the school. It was constructed by adding nonreserve code values of BYSC13-A-D and categorizing the result. If the school questionnaire was missing of if BYSC1A-D was missing, G8MINOR was set to missing.

0=None
1=1-5%
2=6-10%
3=11-20%
4=21-40%
5=41-60%
6=61-90%
7=91-100%

Percent free lunch (G8LUNCH)

Categorizes the percentage of free or reduced price lunch calculated for the school questionnaire. It was constructed by dividing BYSC16A by BYSC2, multiplying by 100, rounding to the nearest whole number, and coding the result. If the school questionnaire was missing, and BYS16A was missing, G8LUNCH was set to missing. In this report several categories were collapsed to the following:

1= <=5%
2=6-20%
3=21-50%
4=>50%

Constructed school climate composites

There were three school-level "environment" composites that were created from variables taken from the administrator file. Scales were created by combining responses to several items asked of the school administrators. Caution should be taken when interpreting these variables in the tabulations since they are school-level and not student-teacher level. For example, a variable such as "teacher engagement" refers to a whole school, not just the eighth grade math or science teachers. The table below shows the scales created and the input variables for each. For each of these scales, a factor analysis and a reliability analysis showed the feasibility of combining the items into a scale. (The alpha statistic for each scale is shown in the table below.)

Student behavior problems
1=Low
2=Moderate
3=Serious

Teacher engagement
1=Low
2=Moderate
3=High

Academic press
1=Low
2=Moderate
3=High

Composites for school environment

Source	Scale	Alpha statistic
BYSC47E BYSC47G BYSC47M BYSC47I * BYSC47H * BYSC47A *	Teacher engagement	.73
BYSC47C BYSC47E BYSC47F BYSC47O	Academic press	.71
BYSC49A BYSC49B BYSC49C BYSC49D BYSC49E BYSC49F BYSC49G BYSC49H BYSC49I BYSC49J BYSC49K	Student behavior problems	.88

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* These items were reverse-coded for consistency of scaling.

Instructional characteristics

The following is a description of the variables constructed for the mathematics and science instructional characteristics.

Class Type

MATH (Composite created from BYS67A--Attend remedial math, BYS67B--Attend regular math, BYS67C--Attend algebra, BYS67D--In advanced/accelerated math)

1=Algebra or advanced (only)
2=Regular + algebra or advanced math
3=Regular math only
4=Any remedial (any mention of remedial math, regardless of other math vars)

SCIENCE (Composite created from BYS67AA--Attend laboratory, BYS67AB--Attend science, BYS67AC--Attend biology, BYS67AD--Attend earth science)

1=Class with laboratory (Attend lab and at least one other science class)
2=Class without laboratory (Don't attend lab but do attend at least one science class)

Teacher characteristics

# Years Taught (BYT3_4 -- Years taught elementary/secondary level)
1=1 to 3 years
2=4 to 9 years (collapsed codes 2–3)
3=10 to 18 years (collapsed codes 4–6)
4=GE 19 years (collapsed codes 7–9)

Highest Degree (BYT3_8 -- Highest degree held)
1=B.A. (code 2)
2=Post grad (collapsed codes 3–5)
3=< B.A. (code 1)

Certificate type (BYT3_6 -- Type of teacher certification)
1=Reg. State
2=Prob or temp (probationary or temporary -- collapsed codes 2–3)
3=No cert (not certified)

B.A. subject (composites of BYT3_9A1--BA major in Ed.; BYT3_9D1--BA major in math, and BYT3_9D2--BA minor in math; BYT3_9E1--BA major in science, BYT3_9E2--BA minor in science)
1=BA major in mathematics or math education [or science]
2=BA minor in mathematics or math education [or science] (if not major)
3=BA major in education only (if not major or minor in mathematics or math education [or science])
4=Other (any other subject)

Class characteristics

Class size (BYT2_3 -- Number of students enrolled in class, coded directly from numbers)
1=1–15 pupils
2=16–25 pupils
3=26–30 pupils
4=More than 30

Class time (BYT2_15 -- Number of hours per week class meets)
1=3 hrs or less (collapsed codes 0–3)
2=4 hours
3=5 hours
4=6 hrs or more (collapsed codes 6–10)

Hrs. of homework (BYT2_7H -- How much homework per week - hours)
1=None
2=1 to 3 hrs (collapsed codes 1–3)
3=4 or more (collapsed codes 4–12)

Teacher preparation (BYT2_14 -- How prepared teacher feels to teach course)
1=Well to very (collapsed codes 1–2)
2=Adequate
3=Some or unprep (collapsed codes 4–5)

Equipment availability

Calculator access (BYT2_21 -- Students have access to calculators)
1=Yes
2=No

Calculator use (BYT2_22 -- How often students use calculators if they have access)
1=Never/little (code 3)
2=Once/week (code 2)
3=> Once/week (code 1)

Microcomputer use (BYT3_32 -- % of students using microcomputers)
1=None
2=< 10% pupils
3=10–25% pupils
4=> 25% pupils (collapsed codes 4–7)

Science experiments and equipment

# Science Experiments (BYT2_26 -- How often students conduct experiments)
1=None or <one/mo (collapsed codes 4–5)
2=About one/mo(code 3)
3=About one/wk (code 2)
4=About one/dy (code 1)

Amount of science equipment (BYT2_28 -- Amount of science equipment for use)
1=For 1–2 pupils (collapsed codes 1–2)
2=Groups 3 or more
3=Little to none

Condition of equipment (BYT2_29 -- Condition of science equipment used)
1=Good to excellent (collapsed codes 1–2)
2=Fair
3=Poor

Instructional time allocation

Instructional time (BYT2_15 -- # hours/week class meets divided by BYT2_16A <providing instruction to whole class>, BYT2_16B <small groups>, BYT2_16C <individuals>, or BYT2_16D <maintaining order> in hours, assuming "less than one hour" is .5 hours and "five or more hours" is 5 hours)

Whole group time
1=<25% of time
2=25–75% of time
3=>75% of time

Small group time, Individ. time, Time keep order
1=None
2=1–20% of time
3=>20% of time

Mathematics subjects

A student was determined to be receiving instruction in the following topics if the teacher indicated that the subject was taught as a "major topic" (code=1).

Integers (BYT2_20H -- Emphasis given to integers)
Fractions: com/dec (BYT2_20A or BYT2_20B -- Emphasis given to common or decimal fractions)
Problem solving (BYT2_20J -- Emphasis given to problem solving)
Ratio/percents (BYT2_20C or BYT2_20D -- Emphasis given to ratio and proportions or to percents)
Measurement (BYT2_20E -- Emphasis given to measurement)
Geometry (BYT2_20F -- Emphasis given to geometry)
Algebra (BYT2_20G -- Emphasis given to algebra)
Prob/stat (BYT2_20I -- Emphasis given to probability/statistics)

Science subjects

A student was determined to be receiving instruction in the following topics if the teacher indicated that the subject was taught as a "major topic" (code=1).

Plants/animal (BYT2_24A or BYT2_24B -- Emphasis given to plants or animals)
Biology/genetics (BYT2_24C or BYT2_24D -- Emphasis given to human biology or genetics)
Earth science (BYT2_24F -- Emphasis given to earth science)
Weather/astronomy (BYT2_24G or BYT2_24H --Emphasis given to weather or astronomy)
Physics subjects (BYT2_24I or BYT2_24J or BYT2_24K or BYT2_24L or BYT2_24L -- Emphasis given to electricity, mechanics, heat, or optics)
Chemistry (BYT2_24M -- Emphasis given to chemistry)
Atomic theory (BYT2_24N -- Emphasis given to atomic theory)
Env. sci/ocean (BYT2_24O or BYT2_24P -- Emphasis given to environmental science or oceanography)
Sci/society (BYT2_24Q-- Emphasis given to science / society)
Personal health (BYT2_24E -- Emphasis given to personal health)

Attitudes toward mathematics and science

If codes were 1 or 2 "strongly agree" or "agree")

MATH: BYS69A -- Usually look forward to class; SCIENCE: BYS72A
MATH: BYS69B -- Afraid to ask questions in class; SCIENCE: BYS72B
MATH: BYS69C -- Will be useful to my future; SCIENCE: BYS72C

Appendix B

Standard Errors of Estimates in Tables and Figures Presented in the Text

Table 1--Data for table 2.1

Standard errors for percent of 1988 public school eighth graders who reported attending various types of mathematics classes, by selected background characteristics: Public schools

	Algebra and/or advncd	Enriched	General only	Any remedial	Unweighted N
Total	0.960	0.630	0.931	0.344	8547
Race					
Asian/Pacific Isl.	3.092	2.329	2.684	1.629	486
Hispanic	1.590	1.979	1.894	1.093	1096
Black	1.806	1.485	1.965	0.965	1094
White	1.157	0.682	1.057	0.355	5728
Am. Indian/Alaskan Nat.	4.050	5.514	6.378	4.457	76
SES					
Low 25%	1.076	1.029	1.374	0.796	2412
Middle 50%	1.120	0.721	1.139	0.447	4262
High 25%	1.512	0.853	1.534	0.486	1871
Math test quartile					
Low	0.874	1.029	1.369	0.965	2103
Middle	1.184	0.812	1.262	0.365	4124
High	1.844	0.818	1.634	0.250	2023

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 2--Data for table 2.2
Standard errors for percent of 1988 public school eighth graders whose teachers reported varying exposure to laboratory experimentation

Number of science experiments conducted	
Unweighted N	8376
None or less than one per month	1.841
About one per month	1.798
About one per week	2.398
Almost every day	1.610
Amount of science equipment available	
Unweighted N	8360
Little to none	1.678
For groups of 1 or 2 students to share	2.007
For groups of 3 or more to share	2.088
Condition of science equipment if available	
Unweighted N	7937
Poor	1.444
Fair	2.163
Good to excellent	2.368

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 3--Data for table 2.3

Standard errors for percentage of 1988 eighth graders in science classes whose science teachers reported varying exposure to scientific experiments, by selected background characteristics: Public schools

	Number of science experiments				
	None or < one/mo	About one/mo	About one/week	About one/day	Unweighted N
Total	1.841	1.798	2.398	1.610	8376
SES					
Low 25%	2.647	2.142	2.848	1.609	2277
Middle 50%	1.924	1.962	2.558	1.604	4236
High 25%	1.650	1.997	3.115	2.741	1862
Race					
Asian/Pacific Isl.	2.733	3.357	4.546	3.554	480
Hispanic	4.623	3.963	6.431	2.227	1091
Black	3.307	3.199	4.058	2.540	1023
White	2.055	2.036	2.661	1.848	5539
Am. Indian/Alaskan Nat.	13.737	5.263	11.672	2.193	142
Community type					
Urban	3.559	2.993	4.145	3.407	1982
Suburban	2.476	2.577	3.634	2.659	3512
Rural	3.579	3.407	4.334	2.361	2882
Percent free lunch					
<=5%	3.624	3.084	5.435	4.238	1495
6-20%	2.906	3.698	4.134	3.772	2371
21-50%	3.218	3.149	3.979	2.021	3154
>50%	5.694	4.088	6.052	2.573	1241

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 4--Data for table 2.4 (total line) and figure 2.1
Standard errors for percentage of 1988 eighth graders whose math teachers who reported various subjects covered as major topics, by class type students report attending

	Integers	Frctns com/dec	Problm solving	Ratio/ percnts	Measurement	Geometry	Algebra	Prob/ stat
Total	1.543	1.471	1.571	1.201	1.735	1.803	1.556	1.535
- unwtd N	8981	8988	9159	8982	8983	8984	8978	8945
Class type								
Algebra or advanced	1.703	2.027	1.807	2.231	1.516	2.129	1.122	1.522
- unwtd N	2469	2471	2504	2470	2470	2470	2470	2462
Regular+algebra/adv	2.262	2.114	2.358	1.677	2.748	2.531	2.436	2.383
- unwtd N	1407	1407	1453	1405	1407	1407	1406	1399
Regular only	2.147	1.743	1.937	1.150	2.198	2.314	2.271	1.915
- unwtd N	3935	3937	3994	3936	3936	3936	3934	3916
Any remedial	3.057	2.118	2.858	2.620	3.062	3.092	2.821	2.095
- unwtd N	581	583	596	581	582	582	579	580

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 5--Date for table 2.5 and table 2.6 (region only; see next table for rest of table 2.6)
Standard errors for percentage of 1988 eighth graders whose mathematics teachers reported algebra and fractions as major topics, by selected background characteristics: Public schools

	Algebra	Fractions common/decimal
Total	1.556	1.471
- unwtd N	8978	8988
SES		
Low 25%	2.326	1.867
- unwtd N	2603	2608
Middle 50%	1.651	1.573
- unwtd N	4458	4461
High 25%	1.666	2.068
- unwtd N	1914	1916
Race		
Asian/Pacific Isl.	3.248	3.542
- unwtd N	515	515
Hispanic	4.236	2.499
- unwtd N	1168	1171
Black	3.106	2.041
- unwtd N	1183	1184
White	1.733	1.714
- unwtd N	5954	5960
Am. Indian/Alaskan Nat.	6.357	4.110
- unwtd N	79	79
Language Proficiency		
Not limited English	1.569	1.492
- unwtd N	8682	8691
Limited English	5.573	4.705
- unwtd N	238	239
Region		
Northeast	3.640	3.500
- unwtd N	1503	1504
North Central	3.169	3.275
- unwtd N	2410	2410
South	2.503	2.250
- unwtd N	3253	3262
West	3.150	2.788
- unwtd N	1785	1785

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 6--Data for table 2.6
Standard errors for percentage of 1988 eighth graders whose mathematics teachers reported algebra and fractions as major topics, by selected background characteristics: Public schools

	Algebra	Fractions common/decimal
Community type		
Urban	3.054	2.483
- unwtd N	2183	2185
Suburban	2.088	2.141
- unwtd N	3658	3662
Rural	2.956	2.816
- unwtd N	3137	3141
Percent free lunch		
<=5%	3.201	3.636
- unwtd N	1687	1689
6-20%	2.561	2.477
- unwtd N	2670	2673
21-50%	2.541	2.434
- unwtd N	3127	3130
>50%	4.720	3.775
- unwtd N	1494	1496
Student problems		
Serious	3.146	2.524
- unwtd N	2365	2370
Moderate	2.009	1.997
- unwtd N	5426	5431
Low	4.129	3.807
- unwtd N	1187	1187
Teacher engagement		
Low	2.867	2.774
- unwtd N	2926	2931
Moderate	2.119	2.002
- unwtd N	4803	4808
High	3.919	3.644
- unwtd N	1249	1249
Academic press		
Low	3.016	2.961
- unwtd N	2300	2304
Moderate	2.080	1.969
- unwtd N	4717	4723
High	3.422	3.377
- unwtd N	1961	1961

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 7--Data for table 2.7 (public schools only) and figure 3.2
Standard errors for percentage of 1988 eighth graders whose science teachers who reported various subjects covered as major topics, by school type

	Plants/ animal	Biolgy/ genetc	Earth sci	Weathr/ astrnmy	Physics subjcts	Chem-istry	Atomic theory	Env.sci/ Ocean	Sci/ society	Persnl health
Total	1.824	2.005	2.272	2.155	2.196	2.184	2.105	2.042	1.701	1.298
- unwtd N	10633	10620	10625	10631	10630	10586	10617	10628	10611	10526
School type										
Public	1.987	2.117	2.466	2.327	2.392	2.387	2.290	2.222	1.862	1.297
- unwtd N	8392	8402	8386	8390	8389	8370	8378	8389	8372	8294
Catholic	5.379	8.491	7.232	7.159	7.287	7.135	7.484	6.765	5.884	7.310
- unwtd N	1053	1030	1053	1053	1053	1030	1053	1053	1053	1044
Private, religious	10.311	10.256	10.337	11.277	7.683	4.124	5.519	6.632	2.539	8.614
- unwtd N	466	466	464	466	466	464	464	464	464	466
Private, non-relig.	2.148	10.312	11.193	13.864	11.980	11.133	10.295	14.970	1.723	2.065
- unwtd N	722	722	722	722	722	722	722	722	722	722

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 8--Data for table 2.8a

Standard errors for percentage of 1988 eighth graders whose mathematics teachers reported classes of varying size, by selected background characteristics: Public schools

	Mathematics Class size				
	1-15 pupils	16-25 pupils	26-30 pupils	More than 30	Unweighted N
Total	0.974	1.570	1.412	1.092	9019
SES					
Low 25%	1.256	2.145	2.024	1.460	2622
Middle 50%	1.056	1.674	1.509	1.112	4478
High 25%	1.334	2.287	1.995	1.791	1916
Race					
Asian/Pacific Isl.	2.061	3.655	3.136	3.609	517
Hispanic	1.156	2.908	3.465	2.637	1190
Black	1.825	3.231	2.692	2.984	1208
White	1.126	1.777	1.581	1.054	5942
Am. Indian/Alaskan Nat.	5.887	6.195	5.938	3.572	81
Region					
Northeast	2.741	3.447	3.234	2.196	1490
North Central	2.232	3.379	2.703	1.816	2435
South	1.048	2.603	2.233	1.809	3282
West	2.329	2.713	3.488	3.339	1785

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 9--Data for table 2.8b

Standard errors for percentage of 1988 eighth graders whose science teachers reported classes of varying size, by selected background characteristics: Public schools

	Science Class size				
	1-15 pupils	16-25 pupils	26-30 pupils	More than 30	Unweighted N
Total	0.723	1.834	1.646	1.300	8384
SES					
Low 25%	1.153	2.440	2.274	1.961	2288
Middle 50%	0.761	2.002	1.799	1.303	4241
High 25%	0.668	2.439	2.105	1.796	1854
Race					
Asian/Pacific Isl.	1.625	3.771	3.550	4.330	477
Hispanic	1.391	3.950	3.209	3.577	1097
Black	1.226	3.038	2.856	3.290	1026
White	0.841	2.021	1.889	1.223	5539
Am. Indian/Alaskan Nat.	2.219	8.006	5.422	3.891	144
Region					
Northeast	1.727	4.475	3.741	2.899	1221
North Central	1.279	3.805	3.607	1.724	2117
South	1.086	2.712	2.484	2.318	3282
West	2.060	4.018	3.583	3.305	1764

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 10--Data for table 2.9a

Standard errors for percentage of 1988 eighth graders whose mathematics teachers reported various amounts of time teaching the entire class, by selected background characteristics: Public schools

	Whole group time			
	<50% of time	50-75% of time	>75% of time	Unweighted N
Total	1.766	1.818	1.225	8968
SES				
Low 25%	2.384	2.468	1.699	2609
Middle 50%	1.893	1.930	1.326	4453
High 25%	2.144	2.237	1.327	1903
Race				
Asian/Pacific Isl.	3.362	3.798	2.297	515
Hispanic	3.701	3.843	2.088	1176
Black	3.515	3.391	3.184	1193
White	2.017	2.051	1.302	5925
Am. Indian/Alaskan Nat.	5.935	6.322	4.622	79
Region				
Northeast	4.002	4.601	3.464	1484
North Central	3.684	3.732	2.221	2394
South	2.905	2.801	2.201	2163
West	3.767	3.808	1.273	1792

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 11--Data for table 2.9b

Standard errors for percentage of 1988 eighth graders whose science teachers reported various amounts of time teaching the entire class, by selected background characteristics: Public schools

	Whole group time			
	<50% of time	50-75% of time	>75% of time	Unweighted N
Total	2.092	2.073	1.413	8391
SES				
Low	2.576	2.603	1.957	2278
Middle	2.239	2.234	1.492	4248
High	2.875	2.752	1.851	1864
Region				
Northeast	4.002	4.601	3.464	1484
North Central	3.684	3.732	2.221	2394
South	2.905	2.801	2.201	3271
West	3.767	3.808	1.273	1792

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 12a--Data for table 2.10a
Standard errors for percent of 1988 public school eighth graders whose mathematics and science teachers who assigned different amounts of homework

	Math	Science
Hours of homework assigned per week		
Unweighted N	8996	8384
Less than 1	0.647	1.261
1 to less than 3	1.682	1.785
3 to 4	1.350	1.251
more than 4	1.168	0.694

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 12b--Data for table 2.10b
Standard errors for percent of 1988 eighth graders whose mathematics teachers assigned various amounts of homework (hours/week), by class type

	Less than 1	1 to less than 3	3 to 4	More than 4	Unweighted N
Algebra/advanced	.773	2.382	2.023	1.682	2479
Enriched	.826	2.527	2.009	1.913	1416
General	.834	2.017	1.705	1.188	3932
Remedial	1.675	3.054	2.041	2.021	577

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 13--Data for table 2.11
Standard errors for percent of 1988 eighth graders whose mathematics and science teachers reported different availabilities and use of microcomputers and calculators

	Math Class	Science Class
Microcomputer use		
Unweighted N	9076	8518
None	1.930	2.161
Fewer than 10% of students	1.527	1.792
10-25% of students	1.007	1.024
More than 25% of students	1.155	0.958
Calculator Access		
Unweighted N	8926	N/A
No	2.209	N/A
Yes	2.209	N/A
If Access: How much:		
Unweighted N	3972	N/A
Little access	2.814	N/A
Once/week	2.548	N/A
More than once/week	2.548	N/A

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 14--Data for table 2.12a

Standard errors for percentage of 1988 eighth graders who reported various attitudes toward mathematics, by selected background characteristics: Public schools

	Attitudes toward mathematics		
	Look forward	Afraid to ask questions	Important to future
Total	0.839	0.575	0.418
- unwtd N	8751	8736	8723
SES			
Low 25%	1.212	1.028	0.770
- unwtd N	2488	2482	2479
Middle 50%	1.026	0.726	0.544
- unwtd N	4367	4361	4351
High 25%	1.591	1.054	0.877
- unwtd N	1894	1891	1891
Race			
Asian/Pacific Isl.	2.525	2.269	1.677
- unwtd N	494	492	492
Hispanic	1.729	1.614	1.171
- unwtd N	1134	1133	1129
Black	1.611	1.600	0.925
- unwtd N	1118	1114	1112
White	0.954	0.621	0.494
- unwtd N	5858	5850	5844
Am. Indian/Alaskan Nat.	6.248	6.037	5.236
- unwtd N	78	78	77
Percent free lunch			
<=5%	1.639	1.133	1.013
- unwtd N	1630	1630	1622
6-20%	1.567	1.153	0.753
- unwtd N	2638	2633	2631
21-50%	1.366	0.980	0.705
- unwtd N	3012	3006	3006
>50%	1.769	1.300	0.933
- unwtd N	1471	1467	1464

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 15--Data for table 2.12b

Standard errors for percentage of 1988 eighth graders who reported various attitudes toward science, by selected background characteristics: Public schools

	Attitudes toward science		
	Look forward	Afraid to ask questions	Important to future
Total	0.847	0.518	0.679
- unwtd N	8193	8182	8167
SES			
Low	1.340	1.060	1.194
- unwtd N	2183	2180	2175
Middle	1.002	0.629	0.885
- unwtd N	4162	4158	4147
High	1.554	1.100	1.194
- unwtd N	1847	1843	1844
Race			
Asian/Pacific Isl.	2.511	1.938	2.127
- unwtd N	477	476	475
Hispanic	1.737	1.316	1.528
- unwtd N	1094	1090	1086
Black	1.569	1.317	1.460
- unwtd N	954	954	957
White	1.023	0.580	0.823
- unwtd N	5434	5428	5417
Am. Indian/Alaskan Nat.	3.973	4.987	3.404
- unwtd N	140	139	139
Percent free lunch			
<=5%	2.121	1.236	1.441
- unwtd N	1617	1618	1612
6-20%	1.603	0.893	1.398
- unwtd N	2310	2307	2305
21-50%	1.311	0.758	1.043
- unwtd N	3071	3068	3065
>50%	1.720	1.686	1.591
- unwtd N	1195	1189	1185

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 16--Data for tables 2.13a and 2.14a
Standard errors for percentage of 1988 eighth graders whose mathematics teachers had various B.A. majors, by selected background characteristics: Public schools

	B.A. subject				
	Major in mathematics/ math education	Minor in mathematics/ math education	Major in Ed	Other subject	Unweighted N
Total	1.864	1.719	1.515	1.132	9075
SES					
Low 25%	2.397	2.332	2.225	1.527	2650
Middle 50%	1.989	1.816	1.541	1.264	4501
High 25%	2.313	2.111	1.678	1.275	1921
Race					
Asian/Pacific Isl.	3.742	3.029	2.556	2.910	515
Hispanic	3.875	3.909	3.250	3.165	1201
Black	3.342	3.136	2.894	2.370	1218
White	2.130	1.981	1.701	1.233	5980
Am. Indian/Alaskan Nat.	6.075	5.613	5.287	4.874	81
Region					
Northeast	4.602	3.749	3.421	2.344	1519
North Central	4.048	3.712	2.970	2.468	2404
South	2.886	2.892	2.627	1.555	3325
West	3.582	3.220	2.980	3.226	1800
Community type					
Urban	3.541	3.084	2.780	2.426	2261
Suburban	2.677	2.461	2.100	1.828	3687
Rural	3.656	3.362	3.006	1.850	3127
Percent free lunch					
<=5%	4.339	3.682	3.143	2.694	1566
6-20%	3.365	2.846	2.314	2.149	2690
21-50%	3.173	3.134	2.822	1.622	3140
>50%	4.848	4.560	4.525	3.905	1568

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 17--Data for tables 2.13b and 2.14b
Standard errors for percentage of 1988 eighth graders whose science teachers who had various B.A. majors, by selected background characteristics: Public schools

	B.A. subject				
	Major in science	Minor in science	Major in Ed	Other subject	Unweighted N
Total	2.277	1.825	1.659	1.527	8517
SES					
Low 25%	2.858	2.314	2.254	1.987	2320
Middle 50%	2.453	1.996	1.730	1.508	4311
High 25%	2.632	2.171	1.877	2.152	1885
Race					
Asian/Pacific Isl.	3.477	3.109	2.400	2.243	496
Hispanic	6.345	3.605	4.695	4.054	1123
Black	3.627	2.755	2.720	2.780	1042
White	2.594	2.094	1.874	1.715	5607
Am. Indian/Alaskan Nat.	9.805	12.015	2.541	2.297	146
Region					
Northeast	6.396	4.131	2.816	4.945	1267
North Central	5.052	4.189	3.989	2.370	2147
South	3.126	2.737	2.808	2.337	3277
West	5.147	4.231	3.131	3.365	1826
Community type					
Urban	3.722	2.999	2.814	2.623	2025
Suburban	3.155	2.718	2.173	1.797	3594
Rural	4.361	3.467	3.362	3.239	2898
Percent free lunch					
<=5%	4.962	4.041	3.917	2.982	1551
6-20%	4.081	3.457	2.586	2.023	2382
21-50%	3.685	3.310	3.075	2.106	3204
>50%	6.556	4.179	4.278	5.670	1264

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 18--Data for table 2.15

Standard errors for percentage of 1988 eighth graders whose mathematics teachers had varying years of teaching experience, by selected background characteristics: Public schools

	Number of years taught				
	1 to 3 years	4 to 9 years	10-18 years	GE 19 years	Unweighted N
Mathematics teachers (total)	1.277	1.499	1.805	1.812	9082
Region					
Northeast	2.899	3.380	4.724	4.380	1519
North Central	1.534	3.506	3.598	4.006	2394
South	2.454	2.191	3.000	2.707	3342
West	3.057	3.341	3.200	4.044	1800
Science teachers (total)	1.342	1.628	2.185	2.148	8553
Region					
Northeast	3.204	3.442	5.808	6.445	1277
North Central	2.913	2.724	4.830	4.306	2147
South	1.713	2.853	3.328	2.749	3303
West	3.641	3.907	4.108	4.955	1826

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 19--Data for table 2.16
Standard errors for percent of 1988 public school eighth graders whose science and mathematics teachers reported various levels of preparedness to teach

	Well to very well prepared	Adequately prepared	Somewhat or unprepared	Unweighted N
Science teachers	1.512	1.312	0.853	8416
Math teachers	0.711	0.690	0.165	9028

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 20--Data for table 3.1
Standard errors for percent of 1988 eighth graders who reported attending different types of math classes, by school type

	Algebra and/or advncd	Enriched	General only	Any remedial	Unweighted N
Total	0.933	0.584	0.882	0.329	10695
School type					
Public	0.960	0.630	0.931	0.344	8547
Catholic	4.270	1.857	3.445	1.491	1026
Private, religious	6.338	3.312	5.754	1.280	507
Private, non-relig.	5.666	1.762	5.892	1.267	615

SOURCE: U.S. Department of Education, National Center for Education Statistics National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 21--Data for figure 3.1
Standard errors for percentage of 1988 eighth graders whose mathematics teachers reported various subjects taught as major topics, by selected background characteristics

	Integers	Fractions com/dec	Problem solving	Ratio/ percents	Measurement	Geometry	Algebra	Prob/ stat
Total	1.431	1.450	1.502	1.161	1.642	1.727	1.452	1.484
- unwtd N	11188	11190	11414	11203	11188	11190	11199	11126
School type								
Public	1.543	1.471	1.571	.201	1.735	1.803	1.556	1.535
- unwtd N	8981	8988	9159	8982	8983	8984	8978	8945
Catholic	3.919	7.051	6.272	5.003	7.089	7.669	5.102	7.403
- unwtd N	1087	1087	1101	1098	1087	1083	1098	1087
Private, other religious	9.857	9.650	10.025	8.021	7.821	10.188	7.437	6.341
- unwtd N	499	502	521	502	502	502	502	502
Private, non-religious	7.384	14.024	4.722	11.501	10.102	9.546	8.101	8.954
- unwtd N	621	613	633	621	616	621	621	592

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 22--Data for figure 3.2

Standard errors for percentage of 1988 eighth graders whose science teachers who reported various subjects covered as major topics, by school type

	Plants/ animal	Biolgy/ genetc	Earth sci	Weathr/ astrnmy	Physics subjcts	Chem- istry	Atomic theory	Env.sci/ Ocean	Sci/ society	Persnl health
Total	1.824	2.005	2.272	2.155	2.196	2.184	2.105	2.042	1.701	1.298
- unwtd N	10633	10620	10625	10631	10630	10586	10617	10628	10611	10526
School type										
Public	1.987	2.117	2.466	2.327	2.392	2.387	2.290	2.222	1.862	1.297
- unwtd N	8392	8402	8386	8390	8389	8370	8378	8389	8372	8294
Catholic	5.379	8.491	7.232	7.159	7.287	7.135	7.484	6.765	5.884	7.310
- unwtd N	1053	1030	1053	1053	1053	1030	1053	1053	1053	1044
Private, religious	10.311	10.256	10.337	11.277	7.683	4.124	5.519	6.632	2.539	8.614
- unwtd N	466	466	464	466	466	464	464	464	464	466
Private, non-relig.	2.148	10.312	11.193	13.864	11.980	11.133	10.295	14.970	1.723	2.065
- unwtd N	722	722	722	722	722	722	722	722	722	722

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 23--Data for figure 3.3a
Standard errors for percentage of 1988 eighth graders whose science teachers reported various exposure to scientific experiments, by school type

	Number of science experiments				
	None or < one/month	About one/month	About one/week	About one/day	Unweighted N
Total	1.739	1.686	2.224	1.421	10602
School type					
Public	1.841	1.798	2.398	1.610	8376
Catholic	6.682	6.097	8.092	0.000	1053
Private, religious	10.873	10.631	4.219	2.336	466
Private, non-religious	0.874	8.854	11.436	6.572	707

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 24--Data for figure 3.3b
Standard errors for percentage of 1988 eighth graders whose science teachers reported various amounts of scientific equipment, by school type

	Amount of science equipment			
	For 1-2 pupils	Groups 3 or more	Little to none	Unweighted N
Total	2.007	2.088	1.678	10586
School type				
Public	2.172	2.228	1.747	8360
Catholic	5.510	8.429	7.961	1053
Private, religious	10.359	7.641	8.422	466
Private, non-religious	14.532	3.510	15.181	707

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 25--Data for figure 3.4a

Standard errors for percentage of 1988 eighth graders whose mathematics teachers reported classes of different sizes, by school type

	Class size				
	1-15 pupils	16-25 pupils	26-30 pupils	More than 30	Unweighted N
Total	0.951	1.488	1.358	1.084	11199
School type					
Public	0.974	1.570	1.412	1.092	9019
Catholic	4.082	5.976	6.357	6.377	1098
Private, religious	9.841	8.855	7.665	0.000	502
Private, non-religious	8.119	8.713	3.548	0.000	580

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 26--Data for figure 3.4b

Standard errors for percentage of 1988 eighth graders whose science teachers reported classes of different sizes, by school type

	Class size				
	1-15 pupils	16-25 pupils	26-30 pupils	More than 30	Unweighted N
Total	0.752	1.762	1.561	1.273	10625
School type					
Public	0.723	1.834	1.646	1.300	8384
Catholic	3.724	8.283	7.078	6.966	1053
Private, religious	9.288	9.912	0.000	6.375	466
Private, non-religious	11.297	12.509	15.722	0.000	722

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 27--Data for figure 3.5
Standard errors for percentage of 1988 eighth graders whose mathematics teachers reported classes that met for varying lengths of time, by school type

	Class time				
	3 hrs or less	Four hours	Five hours	6 hrs or more	Unweighted N
Total	1.131	1.827	1.829	0.391	11231
School type					
Public	1.214	1.915	1.925	0.442	9006
Catholic	3.766	8.257	8.185	0.000	1098
Private, religious	7.533	8.959	9.839	0.037	502
Private, non-religious	7.262	8.389	7.280	0.000	625

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 28--Data for figure 3.6a
Standard errors for percentage of 1988 eighth graders whose mathematics teachers reported spending various lengths of time teaching the entire class, by school type

	Whole group time			
	<50% of time	50-75% of time	> 75% of time	Unweighted N
Total	1.660	1.719	1.145	11169
School type				
Public	1.766	1.818	1.225	8968
Catholic	5.668	6.908	4.443	1074
Private, religious	10.049	8.957	3.940	502
Private, non-religious	14.898	11.305	9.381	625

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 29--Data for figure 3.6b
Standard errors for percentage of 1988 eighth graders whose science teachers reported spending various lengths of time teaching the entire class, by school type

	Whole group time in science class			
	< 50% of time	50-75% of time	> 75% of time	Unweighted N
Total	1.921	1.960	1.359	10625
School type				
Public	2.092	2.073	1.413	8391
Catholic	5.723	7.258	5.208	1053
Private, religious	3.453	10.414	9.781	459
Private, non-relig.	12.745	8.595	14.659	722

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 30--Data for figure 3.7
Standard errors for percentage of 1988 eighth graders whose mathematics teachers assigned different amounts of homework, by school type

	Hours of homework assigned				
	Less than 1	1-2 hrs	3-4 hrs	>4 hrs	Unweighted N
Total	0.589	1.572	1.253	1.106	11221
School type					
Public	0.647	1.682	1.350	1.168	8996
Catholic	0.606	5.980	4.434	5.205	1098
Private, religious	5.001	7.342	5.727	2.517	502
Private, non-religious	0.311	7.498	7.232	0.803	625

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 31--Data for figure 3.8a
Standard errors for percentage of 1988 eighth graders whose mathematics teachers reported various levels of education, by school type

	Highest degree			
	B.A.	Post grad	No degree	Unweighted N
Total	1.791	1.780	0.202	11311
School type				
Public	1.900	1.900	0.000	9101
Catholic	7.233	6.831	2.508	1101
Private, religious	9.029	8.555	2.813	521
Private, non-religious	7.477	7.477	0.000	588

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 32--Data for figure 3.8b
Standard errors for percentage of 1988 eighth graders whose science teachers reported various levels of education, by school type

	Highest degree			
	B.A.	Post grad	No degree	Unweighted N
Total	2.075	2.077	0.138	10777
School type				
Public	2.232	2.233	0.085	8532
Catholic	7.726	7.726	0.000	1055
Private, religious	8.606	8.605	3.635	467
Private, non-religious	13.315	13.315	0.000	723

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 33--Data for figure 3.9a

Standard errors for percentage of 1988 eighth graders whose mathematics teachers reported various B.A. majors, by school type

	B.A. subject				
	Major in mathematics/ math education	Minor in mathematics/ math education	Major in Ed	Other subject	Unweighted N
Total	1.737	1.636	1.464	1.180	11235
School type					
Public	1.864	1.719	1.515	1.132	9075
Catholic	5.878	7.086	7.096	7.394	1074
Private, religious	9.191	8.406	8.569	7.064	499
Private, non-religious	5.633	9.422	3.178	10.828	587

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 34--Data for figure 3.9b

Standard errors for percentage of 1988 eighth graders whose science teachers reported various B.A. majors, by school type

	B.A. subject				
	Major in science/science education	Minor in science/science education	Major in Ed	Other subject	Unweighted N
Total	2.076	1.719	1.608	1.475	10734
School type					
Public	2.277	1.825	1.659	1.527	8517
Catholic	5.931	7.564	8.447	6.139	1055
Private, religious	10.082	5.454	7.833	11.691	439
Private, non-religious	13.909	15.359	0.211	10.444	723

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 35--Data for figure 3.10
Standard errors for percentage of 1988 eighth graders whose mathematics teachers reported varying years of teaching experience, by school type

	Number of years taught				
	1 to 3 years	4 to 9 years	10-18 years	GE 19 years	Unweighted N
Total	1.207	1.403	1.753	1.691	11336
School type					
Public	1.277	1.499	1.805	1.812	9082
Catholic	5.456	5.534	8.069	6.225	1101
Private, religious	3.690	6.722	11.096	8.472	521
Private, non-religious	5.488	7.628	13.724	6.364	632

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 36--Data for table 4.1a
Standard errors for average mathematics achievement test scores of 1988 public school eighth graders who reported attending various levels of mathematics classes

Total	.237
Unweighted N	8797
Mathematics class type reported by students	
Algebra/advanced	.355
Enriched	.328
General only	.269
Any remedial	.391

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 37--Data for table 4.1b
Standard errors for the average mathematics achievement test scores of 1988 public school eighth graders whose mathematics teachers reported various subjects covered as major topics

	S.E.	Unwt. N
Total	0.237	8797
Ratios and percents	0.248	6722
Problem solving	0.269	6414
Integers	0.287	6020
Fractions (common and decimals)	0.246	5887
Algebra	0.313	5194
Geometry	0.319	4349
Measurement	0.342	3233
Probability and statistics	0.516	1708

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 38--Data for table 4.2
Standard errors for the average science achievement test scores of 1988 public school eighth graders whose science teachers reported varying exposure to laboratory experimentation

Number of science experiments conducted	Science test scores	
	S.E.	Unwt. N
Total	0.270	8361
None or less than one per month	0.495	1618
About one per month	0.481	1569
About one per week	0.394	3877
Almost every day	0.607	1059

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 39--Data for table 4.3
Standard errors for the average science achievement test scores of 1988 public school eighth graders whose science teachers reported covering various subjects as major topics

Number of science experiments conducted	Science test scores	
	S.E.	Unwt. N
Total	0.270	8361
Earth science	0.347	4648
Weather/astronomy	0.331	4512
Environmental science/oceanography	0.344	3957
Chemistry	0.356	3773
Various physics subjects	0.381	3362
Atomic theory	0.371	3432
Science/society	0.496	1726
Human biology/genetics	0.601	1463
Plants/animals	0.782	1173
Personal health	0.877	678

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 40--Data for table 4.4

Standard errors for the average mathematics and science achievement test scores of 1988 public school eighth graders in relation to teachers' education, and teaching experience

	Mathematics Scores		Science Scores	
	S.E.	Unwt. N	S.E.	Unwt. N
Total	0.237	8797	0.270	8361
Highest degree earned				
B.A.	0.311	4792	0.363	4449
Post Graduate	0.331	3948	0.372	3813
No Degree	*	*	*	*
B.A. subject				
Majored in subject taught	0.334	3807	0.307	4111
Minored in subject taught	0.419	2352	0.489	1964
Majored in education†	0.488	1557	0.685	1232
Majored in other subject†	0.622	1081	0.926	1054
Number of years teaching				
1 to 3	0.579	918	0.598	990
4 to 9	0.486	1627	0.424	1664
10 or more	0.370	5476	0.450	5639

*Fewer than 50 students

†Teachers fell into this category if mathematics teachers did not minor in mathematics and science teachers did not minor in science.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 41--Data for table 4.5

Standard errors for the average mathematics and science achievement test scores of 1988 public school eighth graders whose teachers reported mathematics and science classes of different sizes and various allocations of class time

	Mathematics Scores		Science Scores	
	S.E.	Unwt. N	S.E.	Unwt. N
Total	.237		.270	
Class size				
1 to 15 students	.683	914	.751	448
16 to 25	.325	3938	.343	3707
26 to 30	.384	2620	.366	2966
More than 30	.612	1189	.712	1011
Hours/week class meets				
3 or Fewer	.905	715	.931	721
Four	.389	2668	.460	2594
Five	.285	5115	.327	4833
6 or More	1.388	108	*	18

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988: "Base Year Student and Teacher" surveys.

Table 42--Data for table 4.6

Standard errors for the average achievement test scores of 1988 public school eighth graders whose mathematics or science teachers assigned different amounts of homework

	Mathematics Scores		Science Scores	
	S.E.	Unwt. N	S.E.	Unwt. N
Total	0.237	8797	0.270	18361
Hours of homework assigned per week				
Less than 1	0.695	939	0.695	939
1 to 2	0.306	5878	0.306	5878
3 to 4	0.641	985	0.641	985
More than 4	1.053	328	1.053	328

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

Table 43--Data for table 4.7
Standard errors for the average achievement test scores of 1988 eighth graders in different types of schools

	Mathematics Scores		Science Scores	
	S.E.	Unwt. N	S.E.	Unwt. N
Total	0.217	10972	0.245	10575
Public	0.237	8797	0.270	8361
Catholic	0.627	1087	0.520	1039
Private, religious	0.803	501	1.089	463
Private, non-religious	0.868	587	1.360	712

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88), "Base Year Student and Teacher" surveys.

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